

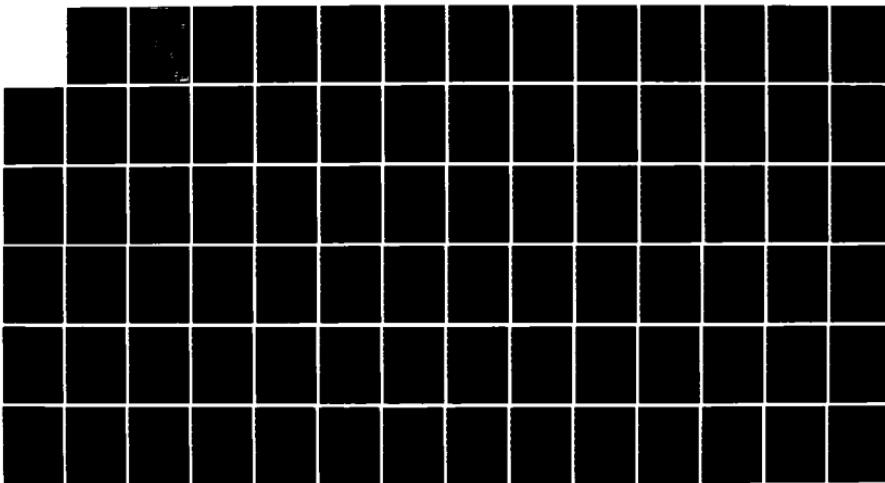
AD-A149 548 A COMPUTER SYSTEM FOR GENERATING SINGLE AND DOUBLE
SAMPLING PLANS FOR ATT. (U) FLORIDA UNIV GAINESVILLE
DEPT OF INDUSTRIAL AND SYSTEMS ENGIN.

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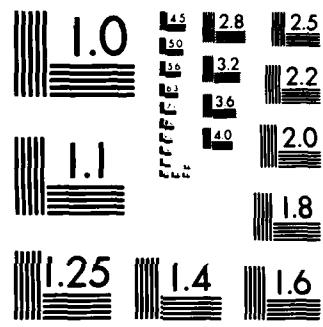
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A COMPUTER SYSTEM FOR GENERATING SINGLE AND DOUBLE
SAMPLING PLANS FOR ATTRIBUTES DATA

Research Report No. 34-35

by

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and

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RESEARCH REPORT

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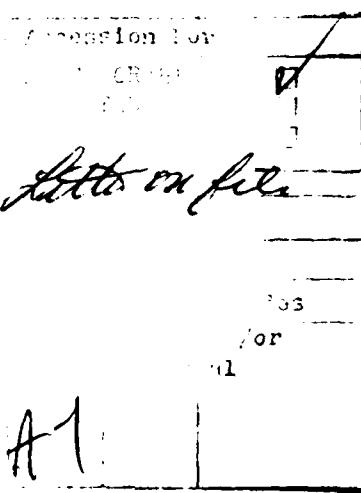
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ABSTRACT

Average Sample Number (ASN),

This study brings together the programs developed in three previous reports into a unified sampling system. One segment contains the single and double sampling plans of MIL-STD-105D along with subroutines that evaluate the normal, tightened and reduced plans including switching rules. Output includes system OC curves, and *ASN*, *AQ*, and *A_{FI}* curves in either graphical or tabular form. Another segment derives single and double sampling plans to satisfy two points designated on the OC curve. An algorithm is employed which seeks to minimize the ASN at a designated Acceptable Quality Level (AQL). The third segment is designed for use when rectifying inspection is employed. It derives single and double sampling plans based on one point on the OC curve, either the process average or a specified AQL value, intended to not exceed a *Average Outgoing Quality Limit* specified *A_{QL}* and minimizing the *A_{FI}* at the process average or specified AQL. Programming is written in FORTRAN IV and development was on a VAX 11-750 computer.



INTRODUCTION

This report brings together the results of three previous studies dealing with acceptance sampling using attributes data. The previous studies dealt with single and double acceptance sample plans. The first involved a computerized version of MIL-STD-105D. The second dealt with the design of double sampling plans in cases where rectifying inspection is not employed. An objective function is introduced which minimizes the average amount of inspection when the process is operating at what is considered an acceptable level. The third study assumes that rectifying inspection is planned based on some specified Average Outgoing Quality Limit and has as an objective function the minimization of inspection when the process is operating at an acceptable level. All computer programming is in ANSI FORTRAN IV and the programs were developed on a VAX 11-750 computer utilizing the VMS operating systems.

DESCRIPTION OF THE PROGRAM SEGMENTS

List of Program Segments

The programming system is composed of seven main segments. Each performs a specific activity with respect to the operation of the system or contains the code for executing the user's choice of sampling plans. These include:

1. Finding and evaluating MIL-STD-105D single and double sampling plans as a system of normal, tightened, and reduced inspection plans.
2. Deriving sampling plans to minimize the Average Sample Number (ASN). or average sample size:
3. Deriving sampling plans to minimize the Average Fraction Inspected (AFI) based on a specified Average Outgoing Quality Limit (AOQL).

The program segments are:

QUALITY.COM A command file that complies and links the program files into an executable file, QMAIN.EXE.

QMAIN.FOR The main program control file from which are called the three sampling plan programs.

QMIL.FOR The program containing MIL-STD-105D sampling plans and the analysis package.

QASN.FOR The program for finding single and double sampling plans based on minimizing the ASN.

QAFI.FOR The program for finding single and double rectifying inspection sampling plans based on minimizing the AFI.

PROBS1.FOR A program for calculating probabilities, binomial or Poisson, for single sampling plans. It is used by QASN.FOR and QAFI.FOR.

PROBD1.FOR A program for calculating probabilities, binomial or Poisson, for double sampling plans. It is used by QASN.FOR and QAFI.FOR.

Program Segment QMIL.FOR

The program QMIL.FOR contains all of the single and double sampling acceptance plans from MIL-STD-105D for normal, tightened, and reduced inspection. They are organized such that the user goes through identically the same procedure as if the Standard were being used. First, an Inspection Level is entered (Special Levels S-1 through S-4 or General Levels I, II, or III) followed by lot or batch size. This leads the program to the selection of the appropriate sample size code letter. The required AQL (Acceptable Quality Level) is entered next. This value must be one of the prescribed values in the Standard. Any other value will lead to extraneous and undesired results. Those values are, expressed in percent defective or defects per 100 units:

0.010, 0.015, 0.025, 0.040, 0.065, 0.10, 0.15, 0.25, 0.40, 0.65, 1.0, 1.5, 2.5, 4.0, 6.5, 10, 25, 40, 65, 100, 150, 250, 400, 650, 1000.

Once a system of sampling plans has been obtained, the user is given the option of having the system analyzed. Output of the analysis may be either in tabular or graphical form. In tabular form, a range of values of p for which the calculations are to be made must be entered. If the user has no idea of the range of p required, it may be desirable to first obtain graphical output and then select the values of p for which accurate results are to be obtained. One caution with respect to graphical output is necessary at this point. In order to obtain clear, easily readable graphical output, the printer unit must be capable of and set on condensed printing. Graphical output uses more space than the standard 80 column pica type font allows. Hence, when restricted to 80 columns, two lines are used for each actual line of output.

Output of the analysis in tabular form appears as follows:

1. The value of p for which the calculation was made.
2. The probability of acceptance.
3. The average sample size (ASN).
4. The average outgoing quality (AOQ).
5. The average fraction inspected (AFI).

Item 3 applies only to those items in samples. Items 4 and 5 apply only if rectifying inspection is being employed; i.e., that all rejected lots are screened of defective units (defects) and are repaired/replaced in the lot in acceptable condition.

The graphical output provides the same information except that curves of the characteristics are plotted rather than numerical values printed. Because of limitations on the type of graphical output, the tabular output will be more accurate.

Analytical results of the program will not correspond exactly with those shown in MIL-STD-105D because the program treats the normal, tightened, and reduced inspection plans, along with the switching rules for changing from one

to the other, as a system of plans and analyzes the entire system rather than each plan individually. The system is analyzed as a Markov chain. Steady state probabilities of being in each of a series of states under normal, tightened and reduced inspection are calculated for each value of p in the effective range of the OC curve. These probabilities are then combined to give probabilities of being in normal, tightened and reduced inspection. From these values are calculated the probabilities of acceptance of lots or batches, the OC curve points, the ASN, AFI, and AOO. As is the case in the Standard itself, each calculation assumes that lots are being formed from a process generating a constant value of p , i.e., a process in statistical control.

Details of the models and procedures are contained in reference (1).

Program Segment QASN.FOR

This program segment enables the user to design custom double sampling plans to minimize the average sample size based on two points on the operating characteristic curve. In the process, it also specifies the minimum single sampling plan that meets the OC curve requirements. The selection of plans based on ASN minimization are intended for use when rectifying inspection either is not or can not be used. Inputs to this program segment include a choice between the binomial and Poisson distributions for calculating probabilities of acceptance, the two specified points on the OC curve, a seed value for the sample size of the equivalent single sampling plan, and a value for the rejection number on the first sample of the double sampling plan.

The output consists of the minimum sampling plan, a series of double sampling plans, the double sampling plan found to have the minimum ASN evaluated at the input good quality level, and the maximum value for the ASN for the R1 value originally input to the program.

The two points designated for the OC curve are related to the traditional Producer's and Consumer's risks. The program uses P_0 to designate the producer's maximum acceptable quality level (an AQL as defined in MIL-STD-105D) or process average with the minimum probability of acceptance set at $(1 - \alpha)$. In this case, α is the designated maximum producer's risk. The quality level P_1 is the designated consumer's maximum acceptable quality level (RQL, or rejectable quality level) with a maximum probability of acceptance of β . In this case, β is the designed maximum Consumer's risk. The equations are of the form:

$$L(P_0) > 1 - \alpha$$

$$L(P_1) < \beta$$

where $L(P)$ is the likelihood function (probability of acceptance formula) for the particular sampling plan being analyzed.

With these two equations alone, an infinite number of sampling plans, single and double, exist which satisfy the inequality constraints. A reasonable choice from among that group is that plan which provides for minimum inspection on the average. Thus an objective function is introduced that minimizes the ASN when the process is operating at or below the AQL. This value is designated ASN or $ASN(P_0)$ on the computer output.

Users familiar with MIL-STD-105D will remember that double and multiple sampling plans in that standard are designed such that their respective ASN's never exceed the sample size of the single sampling plan with the same OC curve. The capability of establishing this additional constraint has been provided for in this program segment. As part of the output, the user receives the maximum value of the ASN reached for each plan analyzed. This value is designated ASN_{MAX} . (The program searches the ASN function as a function of p and outputs that value.) Thus the user may search through the

program output for those plans with a ASNMAX less than or equal to the minimum single sampling plan and select from them the plan with the minimum ASN(P_0). It is worth noting at this point that, in most of the plans explored in the development of this segment, addition of this constraint did not result in changing the optimal choice.

Reference (2) presents detailed findings and a full description of the program's development.

Program Segment QAFI.FOR

This program segment develops single and double sampling plans which meet a specified Average Outgoing Quality Limit (AOQL). They are intended for use only when rectifying inspection (100% inspection of the balance of rejected lots) is employed. Calculations assumes that rectifying inspection is 100% effective and that the binomial distribution provides sufficient accuracy in calculating probabilities of acceptance.

Inputs to this segment include a Producer's Risk Point (P_0 , $1-\alpha$), the desired AOQL (designated AOQL*), and the lot or batch size. Outputs include the minimum single sampling plan satisfying the constraints, a series of double sampling plans all of which satisfy the AOQL constraint, and that plan which satisfies the constraints and minimizes the Average Fraction Inspected (AFI) when the process is operating at the quality level P_0 . The quality level P_0 may be interpreted either as an AQL value as defined in MIL-STD-105D or as a process average as defined and employed in the Dodge-Romig tables. As in the Dodge-Romig tables, the rejection numbers on the first and second samples, R_1 and R_2 , are set at the second acceptance number, C_2 , plus one.

The objective function and constraint equations are of the form:

minimize $AFI(P_0)$

subject to:

$$\begin{aligned}L(P_0) &> 1 - \alpha \\AOQL &\leq AOQL^* \\R_1 &= R_2 = C_2 + 1\end{aligned}$$

First, the program finds the minimum single sampling plan satisfying the likelihood function and AOQL constraints. This information is used internally to assist in setting bounds for the algorithm that solves for the double sampling plans. Then the algorithm shifts to seeking the double sampling plan satisfying the constraints. In its search, a number of plans are found and it is from this group that the plan that minimizes $AFI(P_0)$ is selected. Output includes the sample sizes N_1 , and N_2 , acceptance numbers C_1 and C_2 , and the $AFI(P_0)$, designated simply as AFI .

Reference (3) provides a complete description and analysis of the development and operation of the algorithm and program.

PROGRAM OPERATING INSTRUCTIONS AND OUTPUT

Initializing the Program

In the following instructions, user inputs are in capital letters. A backward arrow (+) indicates a carriage return.

Program initialization begins by entering:

@QUALITY+

This instruction executes the command file (QUALITY.COM) which compiles and links the program files into a single executable file (QMAIN.EXE). If QMAIN.EXE has been created and exists in the file, this step may be eliminated.

Once QMAIN.EXE has been created, the user enters:

RUN QMAIN+

This command starts program execution. Very shortly the following message will appear on the terminal screen:

WHAT DO YOU WISH TO DO?
1-DERIVE SAMPLING PLANS TO MINIMIZE ASN
2-DERIVE SAMPLING PLANS TO MINIMIZE AFI
3-EVALUATE MIL-STD-105D SAMPLING SCHEME
4-EXIT THIS PROGRAM

Entering the number for your selection followed by a carriage return transfers program control to QASN.FOR, QAFI.FOR, QMIL.FOR, or the computer operating system. These instructions are repeated after each run of the program until the user exits with instruction (4).

Running QASN.FOR

Entering number 1 from the main transfers program control to QASN.FOR, the program for generating double sampling plans designed to minimize the ASN at quality level P0. What follows is the menu QASN.FOR.

The first question in this menu asks you to name an output file (8 alphanumeric characters or less).

WHAT DO YOU WISH TO CALL YOUR OUTPUT FILE?

User enters a name and +.

Subsequent questions are:

CODES FOR SELECTING APPR. PROB. DIST.
BINOMIAL =1
POISSON =2

User then enters the appropriate code. The Poisson uses the intensity parameter $\lambda = np$ in terms of defects per 100 units.

SELECT
SAMPLE PLANS ONLY = 1
ASN VALUES ONLY = 2
OR BOTH = 3

The most useful of these choices is to enter 3. Entering 1 produces an output of a large number of sampling plans all of which meet the criteria for the two points on the OC curve. Output includes the values of C1, C2, and N1, the range over which N2 may operate, and the probabilities of acceptance at P1 and P0, respectively. Entering 2 results in the production of a large number of plans satisfying the OC curve constraints and lists values of ASNMAX and ASN(P0). When 3 is entered, the optimization algorithm is called in thus the output is limited to those plans which were considered candidates for the optimum. Output includes C1, C2, and N1, the effective range for N2, and the ASNMAX and ASN(P0) when the smallest value of N2 is used. It then selects the global optimum plan for the input value of R1.

INPUT ALPHA	User enters the Producer's Risk, α +
INPUT BETA	User enters the Consumer's Risk, β +
INPUT P0	User enters P_0 +
INPUT P1	User enters P_1 +

INPUT A SEED FOR THE SINGLE SAMPLING NO.
IF NO SEED AVAILABLE ENTER ZERO AS THE SEED VALUE

If the user has some idea what the sample size will be for the single sampling plan satisfying the OC curve requirements, a conservative value somewhat lower than that number may be entered. This option is useful only when the sample size is known to be large and user wishes to save some time. Its use may lead to nonoptimal results if the seed value is larger than the optimal value.

INPUT A VALUE FOR (R1 - C2)
IF R1 = C2 THEN THE VALUE WOULD BE 0
IF R1 > C2 THEN THE VALUE WOULD BE A POSITIVE NO.
IF R1 < C2 THEN THE VALUE WOULD BE A NEGATIVE NO.

This option allows the user to vary the value of R1 in the search for optimality. Each run of the program provides the optimal plan for a given selected value of R1.

From this point on the program takes over generating the desired output.

Running QAFI.FOR

Entering 2 from the main menu transfers control to QAFI.FOR, the program segment for finding rectifying inspection plans satisfying AOQL and AQL constraints while minimizing the AFI at the AOL level. The menu for QAFI.FOR leads the user as follows:

ENTER VALUE OF ALPHA	User enters Producer's Risk, α +
ENTER VALUE OF PO	User enters quality level PO+
ENTER AOQL VALUE	User enters AOQL+ (in percent)
ENTER LOT SIZE	User enters lot size+

The program then proceeds to generate a series of sampling plans for which $R1 = R2 = C2 + 1$ and selects the optimal plan from among this group. Output includes the values of $C1$, $C2$, $N1$, $N2$, and $AFI(P0)$, respectively, and the optimal plan.

Running QMIL.FOR

Entering 3 from the main menu transfers control to QMIL.FOR, the program segment for finding single and double sampling plans from MIL-STD-105D and, at the user's discretion, evaluating the resulting normal, tightened and reduced inspection plans as a system. Output of the evaluation may be either graphical or tabular. The menu for this segment is as follows:

WHAT DO YOU WISH TO CALL YOUR OUTPUT FILE?

User enters a name for the output file+ (8 alphanumeric characters or less).

ENTER INSPECTION LEVEL IN QUOTATION MARKS
E.G.,: SPECIAL: 'S1', 'S2', 'S3', 'S4'
GENERAL: '1', '2', '3'

User enters the appropriate code followed by +. A note of caution here. Any error on entry will cause program failure and automatic exit. Depending on the terminal being used, it may be necessary to use apostrophe marks rather than quotation marks surrounding the entry.

ENTER LOT SIZE: User enters lot size+

ENTER AOL IN PERCENT. REMEMBER, ONLY A STANDARD AOL IS ALLOWABLE User enters AOL +

DO YOU WANT SINGLE ('S') OR DOUBLE ('D') SAMPLING PLANS; (NOTE: ENTER S OR D IN QUOTES).

The same caution for entry of the inspection level applies here as well.

The program then proceeds to select the desired sampling system from the Standard. Once the plans are displayed, user is asked:

DO YOU WANT SCHEME EVALUATION..?
IF YES ENTER.....1
IF NO ENTER.....2

If the answer to this question is no, program execution stops and the user is presented with the main menu. If the answer is yes, execution continues with:

DO YOU WANT A TABLE OR A GRAPH FORMAT?

FOR GRAPH.....ENTER: 1

FOR TABLE.....ENTER: 2

Entering 1+ for graphical format results in the output of a plot of the OC curve, the ASN curve, the A0Q curve, and the AFI curve. (Naturally, the A0Q and AFI curves have no meaning unless rectifying inspection is intended.) In order for these curves to be readable, the printer must be capable of and set on compressed printing. The horizontal scale of each of the graphs (probability scale in the case of the OC curve) requires more than 80 columns. Thus, if an attempt is made to print graphs in standard 80 column format, the printing will occur on two consecutive lines making the whole thing look very weird.

When 2+ is entered, i.e., a tabular format is requested, the computer returns with the following questions:

SPECIFY THE NUMBER OF FRACTION DEFECTIVE VALUES..

The user must enter the number of values of p for which the equation is to be made.

ENTER THE FRACTION DEFECTIVE VALUE(S).
(PUT A COMMA BETWEEN VALUES.).....

The user then enters the values as fractional quantities, not percents. In this case the output is a table containing p , $P(A)$, ASN, AOQ and AFI, respectively. It may be useful to obtain a graphical output on a first run to obtain the effective range of p required for a good tabular output. Naturally, the table is more accurate than is the graph.

REFERENCES

1. Siddiqi, Azmat H. and R. S. Leavenworth, An Interactive Computerized Approach for Tabulating and Evaluating MIL-STD-105D. ISE Research Report No. 84-30, August, 1984.
2. Rangarajan, R. W., K.W. Beitler, and R. S. Leavenworth. Developing Double Sampling Plans for Attributes to Meet Sample Size Criteria. ISE Research Report 84-32, August, 1984.
3. Walker, Jo Ellen and R. S. Leavenworth. Designing Optimal AOQL Sampling Plans - a Computerized Approach. ISE Research Report No. 84-1, May, 1984.

APPENDIXES

Appendix A contains several example runs for each of the program segments.
The entire program is listed in Appendix B.

APPENDIX A
Program Example Runs

Example 1 QASN.FOR

WHAT DO YOU WISH TO DO?

- 1-DERIVE PLANS TO MINIMIZE ASN
- 2-DERIVE PLANS TO MINIMIZE AFI
- 3-EVALUATE MIL-STD-105D SAMPLING SCHEME
- 4-EXIT THIS PROGRAM

ENTER CHOICE

1

WHAT DO YOU WISH TO CALL YOUR OUTPUT FILE?

PR1

CODES FOR SELECTING APPR. PROB. DIST.

BINOMIAL	=1
POISSON	=2

1

SELECT

SAMPLE PLANS ONLY	=1
ASN VALUES ONLY	=2
OR BOTH	=3

3

INPUT ALPHA

.05

INPUT BETA

.1

INPUT P0

.015

INPUT P1

.05

INPUT A SEED FOR SINGLE SAMPLING NO.

IF NO SEED AVAILABLE ENTER ZERO AS THE SEED VALUE

0

INPUT A VALUE FOR (R1-C2)

IF R1=C2 THEN THE VALUE WOULD BE 0

IF R1>C2 THEN THE VALUE WOULD BE A POSITIVE NO.

IF R1<C2 THEN THE VALUE WOULD BE A NEGATIVE NO.

1

ALPHA = 0.0500 BETA = 0.1000
P0 = 0.0150 P1 = 0.0500

REJECTION NO. OF FIRST SAMPLE (R1) = C2+(1)

SINGLE SAMPLING PLAN
ACCEPTANCE NO. (C) = 6
LOWER BOUND ON N (NS) = 209
UPPER BOUND ON N (NL) = 220

DOUBLE SAMPLING PLANS

FOR C1= 0 C2= 6

(N1)	(N2S)	(N2L)	ASNMAX	ASN
59	166	166	212.4477	156.9425
60	164	165	211.5781	157.7704

DOUBLE SAMPLING PLANS

FOR C1= 1 C2= 6

(N1)	(N2S)	(N2L)	ASNMAX	ASN
89	139	139	201.8087	142.6555
90	136	137	200.3593	143.2139

DOUBLE SAMPLING PLANS

FOR C1= 2 C2= 6

(N1)	(N2S)	(N2L)	ASNMAX	ASN
115	115	116	191.8224	143.4053
116	112	114	190.8090	144.1031

DOUBLE SAMPLING PLANS

FOR C1= 3 C2= 6

(N1)	(N2S)	(N2L)	ASNMAX	ASN
139	94	96	186.4893	153.2870
140	91	94	185.9685	154.0707

DOUBLE SAMPLING PLANS

FOR C1= 4 C2= 6

(N1)	(N2S)	(N2L)	ASNMAX	ASN
161	82	82	188.3876	167.9648
162	76	80	187.3810	168.5728

DOUBLE SAMPLING PLANS

FOR C1= 5 C2= 6

(N1)	(N2S)	(N2L)	ASNMAX	ASN
184	75	87	196.2480	186.8779
185	57	80	194.3076	187.2266

SINGLE SAMPLING PLAN

ACCEPTANCE NO. (C) = 7

LOWER BOUND ON N (NS) = 234

UPPER BOUND ON N (NL) = 266

DOUBLE SAMPLING PLANS

FOR C1= 0 C2= 7

(N1)	(N2S)	(N2L)	ASNMAX	ASN
50	226	228	263.0669	169.8499
51	220	226	260.3219	169.2180
52	215	225	256.5318	169.0233
53	211	223	253.6964	169.2884

DOUBLE SAMPLING PLANS

FOR C1= 1 C2= 7

(N1)	(N2S)	(N2L)	ASNMAX	ASN
81	198	202	252.9615	148.9811
82	192	200	248.7259	148.9649
83	187	198	245.3612	149.2348

DOUBLE SAMPLING PLANS

FOR C1= 2 C2= 7

(N1)	(N2S)	(N2L)	ASNMAX	ASN
108	178	181	242.3765	147.3077
109	170	179	237.3196	147.2064
110	164	177	233.7746	147.5018

DOUBLE SAMPLING PLANS

FOR C1= 3 C2= 7

(N1)	(N2S)	(N2L)	ASNMAX	ASN
134	157	164	231.0574	156.3438
135	147	162	225.8645	156.3163
136	139	160	221.9088	156.5329

DOUBLE SAMPLING PLANS

FOR C1= 4 C2= 7

(N1)	(N2S)	(N2L)	ASNMAX	ASN
159	141	156	224.8282	171.6242
160	125	152	218.3522	171.4111
161	115	149	214.6785	171.7019

DOUBLE SAMPLING PLANS

FOR C1= 5 C2= 7

(N1)	(N2S)	(N2L)	ASNMAX	ASN
184	117	181	220.1528	190.2280
185	96	172	214.6608	190.2104
186	85	165	212.2600	190.7030

DOUBLE SAMPLING PLANS

FOR C1= 6 C2= 7

(N1)	(N2S)	(N2L)	ASNMAX	ASN
209	75	266	220.3671	210.8894
210	57	266	218.6382	211.4632

GLOBAL MINIMUM ASN(P_0)= 142.66

CORRESPONDING N1 = 89

CORRESPONDING N2S = 139

CORRESPONDING C1 = 1

CORRESPONDING C2 = 6

Example 2 QAFI.FOR

WHAT DO YOU WISH TO DO?

- 1- DERIVE PLANS TO MINIMIZE ASN
- 2- DERIVE PLANS TO MINIMIZE AFI
- 3-EVALUATE MIL-STD-105D SAMPLING SCHEME
- 4-EXIT THIS PROGRAM

ENTER CHOICE

2

ENTER VALUE OF ALPHA

.05

ENTER VALUE OF P0

.015

ENTER AOQL VALUE

.02

ENTER LOT SIZE

2000

ALPHA= 0.050000

P0= 0.015000

AOQL= 0.020000

N= 2000

*** SINGLE SAMPLING PLAN ***

NS=120

C= 4

AFI(P0)=0.093093

** DOUBLE SAMPLING PLANS **

C1	C2	N1	N2	AFI
0	4	29	91	0.056349
1	4	55	66	0.060894

C1	C2	N1	N2	AFI
0	5	28	120	0.051799
1	5	55	93	0.054159

C1	C2	N1	N2	AFI
----	----	----	----	-----

0	6	28	147	0.050792
1	6	55	120	0.050957

C1	C2	N1	N2	AFI
----	----	----	----	-----

0	7	28	174	0.051735
1	7	55	147	0.049855
2	7	82	121	0.056638

C1	C2	N1	N2	AFI
----	----	----	----	-----

0	8	28	201	0.053922
1	8	55	174	0.050058
2	8	82	148	0.055690

SAMPLING PLAN MINIMUMS

C1= 1 C2= 7
N1= 55 N2=147
MINIMUM AFI=0.049855

Example 3 QMIL.FOR

WHAT DO YOU WISH TO DO?

- 1-DERIVE PLANS TO MINIMIZE ASN
- 2-DERIVE PLANS TO MINIMIZE AFI
- 3-EVALUATE MIL-STD-105D SAMPLING SCHEME
- 4-EXIT THIS PROGRAM

ENTER CHOICE

3

ENTER INSPECTION LEVEL IN QUOTATION MARKS

E.G. ; SPECIAL :'S1','S2','S3','S4'
GENERAL :'1','2','3'

'2'

ENTER LOT SIZE:

2000

ENTER AQL IN PERCENT. REMEMBER, ONLY A
STANDARD AQL IS ALLOWABLE

1.5

DO YOU WANT SINGLE('S') OR DOUBLE('D')
SAMPLING PLANS ;(NOTE:ENTER S OR D IN QUOTES).

'S'

THESE PLANS ARE:

:NORMAL::::::::::TIGHTENED::::::::::REDUCED:::

AC 1= 5	AC 1= 3	AC 1= 2
RE 1= 6	RE 1= 4	RE 1= 5
<hr/>		
N= 125	N= 125	N= 50

DO YOU WANT SCHEME EVALUATION..?

IF YES ENTER.....1

IF NO ENTER.....2

2

Example 4 QMIL.FOR

WHAT DO YOU WISH TO DO?

- 1-DERIVE PLANS TO MINIMIZE ASN
- 2-DERIVE PLANS TO MINIMIZE AFI
- 3-EVALUATE MIL-STD-105D SAMPLING SCHEME
- 4-EXIT THIS PROGRAM

ENTER CHOICE

3

ENTER INSPECTION LEVEL IN QUOTATION MARKS
E.G.; SPECIAL : 'S1', 'S2', 'S3', 'S4'
GENERAL : '1', '2', '3'

'2'

ENTER LOT SIZE:

2000

ENTER AQL IN PERCENT. REMEMBER, ONLY A
STANDARD AQL IS ALLOWABLE

1.5

DO YOU WANT SINGLE('S') OR DOUBLE('D')
SAMPLING PLANS ;(NOTE:ENTER S OR D IN QUOTES).

'D'

THESE PLANS ARE:

:NORMAL::::::::::TIGHTENED::::::::::REDUCED::

AC 1= 2	AC 1= 1	AC 1= 0
RE 1= 5	RE 1= 4	RE 1= 4
N1= 80	N1= 80	N1= 32

AC 2= 6	AC 2= 4	AC 2= 3
RE 2= 7	RE 2= 5	RE 2= 6
N2= 80	N2= 80	N2= 32

DO YOU WANT SCHEME EVALUATION..?

IF YES ENTER.....1

IF NO ENTER.....2

1

DO YOU WANT A TABLE OR A GRAPH FORMAT ?

FOR GRAPH....ENTER: 1

FOR TABLE....ENTER: 2

DEPT. OF ISE
UNIVERSITY OF FLORIDA

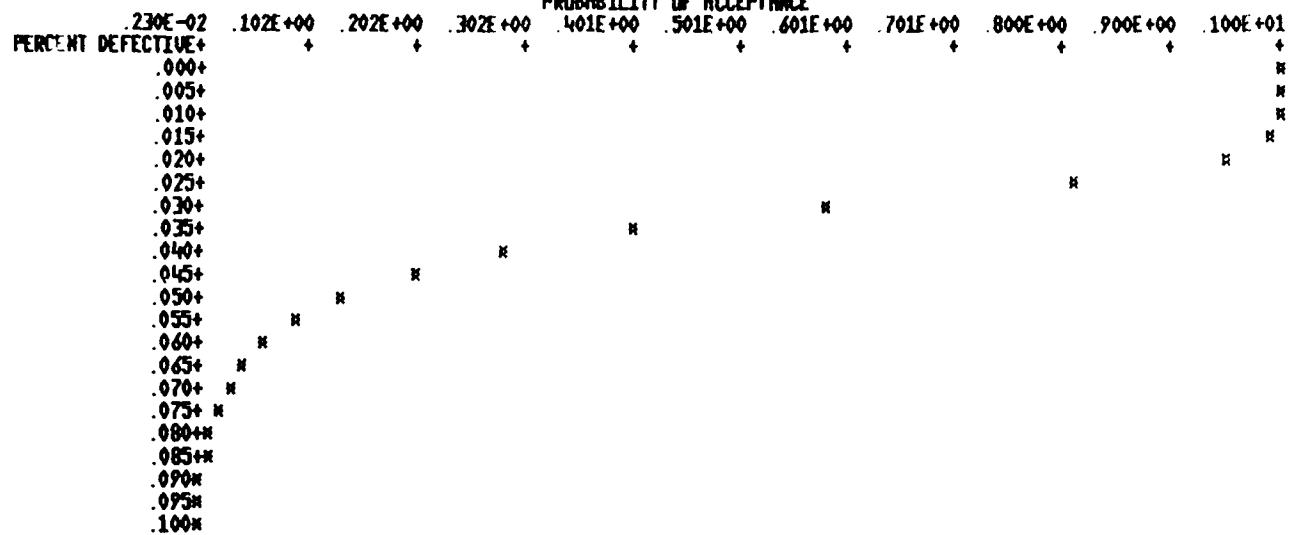
*****SAMPLING SYSTEM TO EVALUATE MIL-STD-105D*****

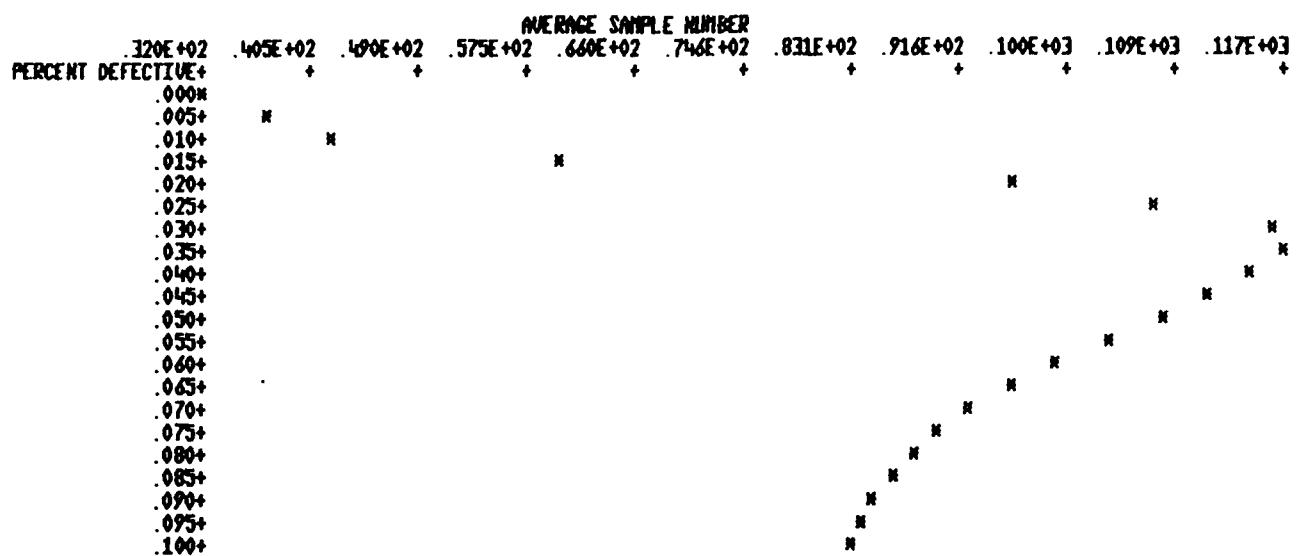
FOR: INSPECTION LEVEL 2
LOT SIZE= 2000
AQL= 1.50000
SAMPLING PLAN D

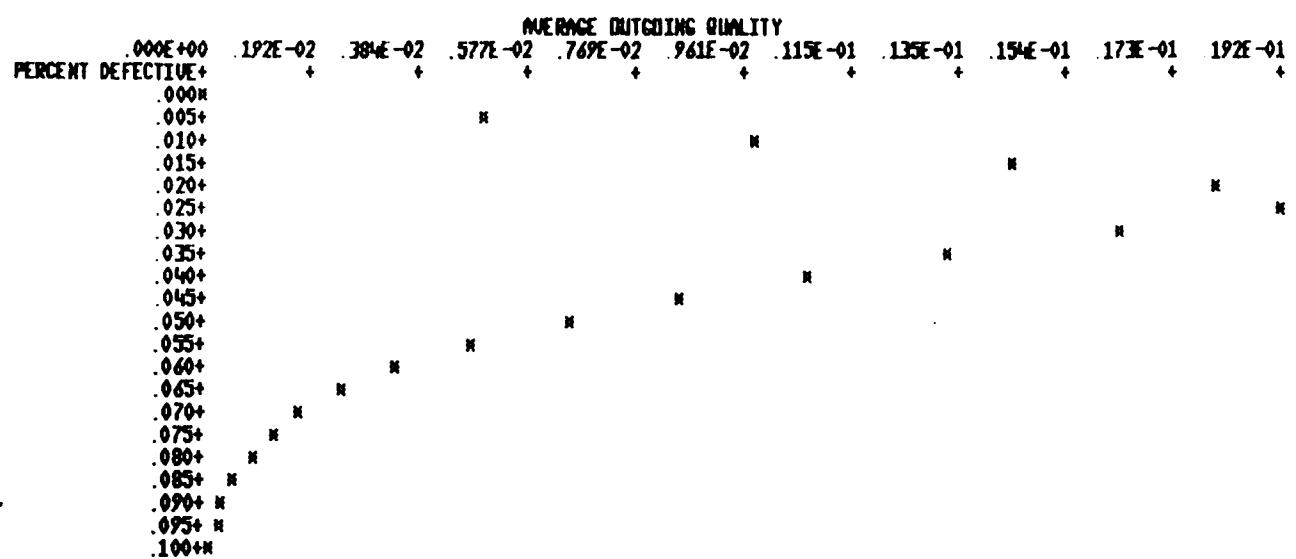
THESE PLANS ARE:

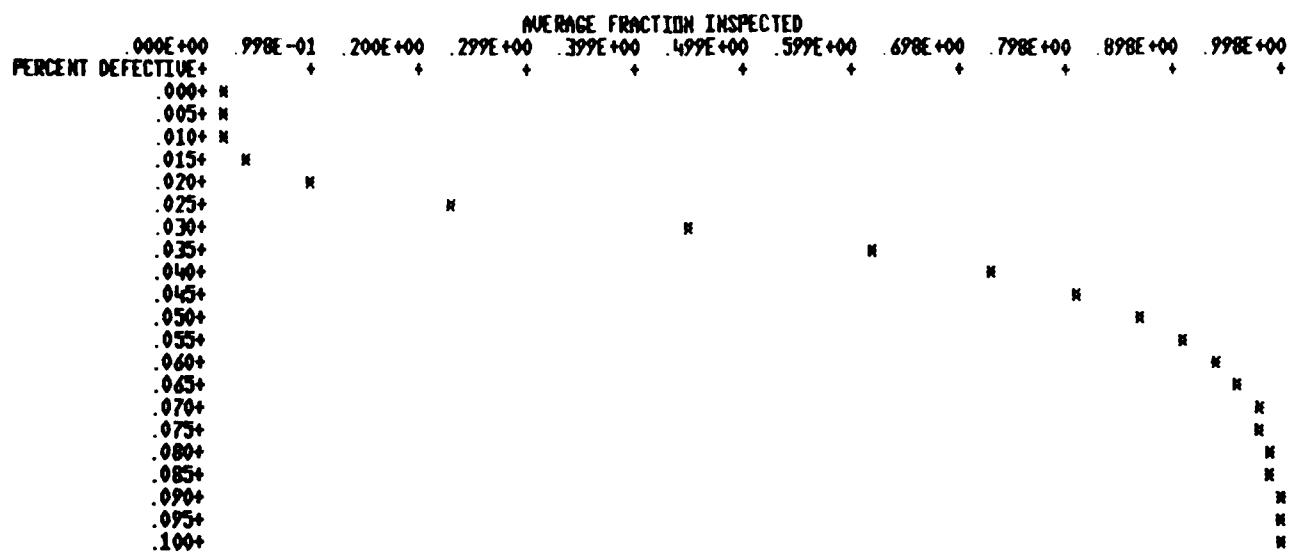
NORMAL			TIGHTENED			REDUCED		
AC 1= 2	AC 1= 1	AC 1= 0	AC 2= 6	AC 2= 4	AC 2= 3	RE 1= 5	RE 1= 4	RE 1= 4
RE 1= 5	RE 1= 4	RE 1= 4	RE 2= 7	RE 2= 5	RE 2= 6	M1= 80	M1= 80	M1= 32
M1= 80	M1= 80	M1= 32	M2= 80	M2= 80	M2= 32			

OPERATING CHARACTERISTIC CURVE
PROBABILITY OF ACCEPTANCE









Example 5 QAFI.FOR

WHAT DO YOU WISH TO DO?

- 1--DERIVE PLANS TO MINIMIZE ASN
- 2--DERIVE PLANS TO MINIMIZE AFI
- 3-EVALUATE MIL-STD-105D SAMPLING SCHEME
- 4-EXIT THIS PROGRAM

ENTER CHOICE

3

ENTER INSPECTION LEVEL IN QUOTATION MARKS

E.G. ; SPECIAL : 'S1', 'S2', 'S3', 'S4'

GENERAL : '1', '2', '3'

'2'

ENTER LOT SIZE:

2000

ENTER AQL IN PERCENT. REMEMBER, ONLY A
STANDARD AQL IS ALLOWABLE

1.5

DO YOU WANT SINGLE('S') OR DOUBLE('D')
SAMPLING PLANS ;(NOTE:ENTER S OR D IN QUOTES).
'D'

THESE PLANS ARE:

:NORMAL::::::::::TIGHTENED::::::::::REDUCED::

AC 1= 2	AC 1= 1	AC 1= 0
RE 1= 5	RE 1= 4	RE 1= 4
N1= 80	N1= 80	N1= 32

AC 2= 6	AC 2= 4	AC 2= 3
RE 2= 7	RE 2= 5	RE 2= 6
N2= 80	N2= 80	N2= 32

DO YOU WANT SCHEME EVALUATION..?

IF YES ENTER.....1

IF NO ENTER.....2

1

DO YOU WANT A TABLE OR A GRAPH FORMAT ?

FOR GRAPH....ENTER: 1

FOR TABLE....ENTER: 2

2

SPECIFY THE NUMBER OF FRACTION DEFECTIVE VALUES..

12

ENTER THE FRACTION DEFECTIVE VALUE(S),

(PUT A COMMA BETWEEN VALUES.).....

.015,.02,.025,.03,.04,.05,.06,.065,.07,.08,.09,.1

SCHEME OPERATING CHARACTERISTICS

P	P(A)	ASN	AQ	AFI
0.015	0.9943	59.80	0.0145	0.04
0.020	0.9467	95.47	0.0180	0.10
0.025	0.8106	107.15	0.0192	0.23
0.030	0.5785	115.85	0.0164	0.45
0.040	0.2833	114.88	0.0107	0.73
0.050	0.1364	107.39	0.0064	0.87
0.060	0.0621	99.40	0.0035	0.94
0.065	0.0413	95.86	0.0026	0.96
0.070	0.0274	92.75	0.0018	0.97
0.080	0.0120	87.90	0.0009	0.99
0.090	0.0053	84.67	0.0005	0.99
0.100	0.0023	82.65	0.0002	1.00

LIMIT NUMBER FOR REDUCED INSPECTION IS:

7

WHAT DO YOU WISH TO DO?

- 1-DERIVE PLANS TO MINIMIZE ASN
- 2-DERIVE PLANS TO MINIMIZE AFI
- 3-EVALUATE MIL-STD-105D SAMPLING SCHEME
- 4-EXIT THIS PROGRAM

ENTER CHOICE

4

FORTRAN STOP

APPENDIX B
Program Listing

Program QMAIN.FOR

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***** CONTROLING PROGRAM FOR THE QUALITY CONTROL
***** INSPECTION SAMPLING SOFTWARE PACKAGE
***** DR. RICHARD S. LEAVENWORTH
***** DEPARTMENT OF INDUSTRIAL AND SYSTEMS ENGINEERING
***** UNIVERSITY OF FLORIDA
***** GAINESVILLE, FLORIDA 32611
***** ****
***** BYTE OUTFILE(8)
***** COMMON/BLK1/N25, N21
***** COMMON/BLK2/PS, PL
***** COMMON/BLK3/N1
***** COMMON/BLK4/ALPHA, BETA
***** COMMON/BLK5/PO, P1
***** COMMON/BLK6/C1, C2
***** COMMON/BLK7/SUM1, OG(4000)
***** COMMON/BLK8/N
***** COMMON/BLK9/C2MAX, C1MAX(15)
***** COMMON/BLK10/NG, NL
***** COMMON/BLK11/ASN, ASNMAX
***** COMMON/BLK12/OUTFIL
***** C
***** NUM=0
10  NUM=NUM+1
***** WRITE(5,15)
15  FORMAT(//11, 23(1), 'WHAT DO YOU WISH TO DO?')
***** WRITE(5,20)
20  FORMAT(//, 15(1), '1-DERIVE PLANS TO MINIMIZE ASN')
***** WRITE(5,25)
25  FORMAT(//, 15(1), '2-DERIVE PLANS TO MINIMIZE AFI')
***** WRITE(5,30)
30  FORMAT(//, 15(1), '3-EVALUATE MIL-STD-105D SAMPLING SCHEME')
***** WRITE(5,35)
35  FORMAT(//, 15(1), '4-EXIT THIS PROGRAM')
***** WRITE(5,40)
40  FORMAT(//11, ' ENTER CHOICE')
***** READ(5,45) ICH
***** 45 FORMAT(11)
***** C
***** IF ((ICH .NE. 1).AND.(ICH .NE. 2).AND.(ICH .NE. 3).AND.
$ (ICH .NE. 4)) THEN
*****   WRITE(5,50)
50  FORMAT(//, 15(1), ' YOU MUST ENTER 1, 2, 3, OR 4')
*****   GO TO 10
***** ENDIF
***** C
***** IF((ICH .NE. 4) .AND. (NUM .EQ. 1)) THEN
*****   WRITE(5,*), ' WHAT DO YOU WISH TO CALL YOUR OUTPUT FILE?'
*****   READ(5,55) OUTFIL
55  FORMAT(10A1)
*****   CALL ASSIGN(1, OUTFIL)
***** ENDIF
***** C
***** GO TO (60, 65, 70, 75), ICH
```

QMAIN\$MAIN

```
0058
0059
0060
0061
0062
0063
0064
0065
0066
60  CALL QAIN
GO TO 10
65  CALL QAI1
GO TO 10
70  CALL QMII
GO TO 10
75  ST(1P
END
```

Program QASN.FOR

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***** QUALITY CONTROL DOUBLE SAMPLING PROGRAM TO ANALYSE
***** DOUBLY SAMPLING PLANS. ASN(PO) AND ASNMAX.
***** BINOMIAL AND POISON PROBABILITY DISTRIBUTIONS USED.
***** PROGRAMED BY R. WAREN RANGARAJAN
***** DEPARTMENT OF INDUSTRIAL AND SYSTEMS ENGINEERING
***** UNIVERSITY OF FLORIDA
***** GAINESVILLE, FLORIDA 32611
***** ****
***** SURROUTINE QASN
***** DOUBLE PRECISION SUMLOG
***** INTEGER C, C1, C2, C1MIN, C2MIN, R1, R11
***** RYTF OUTF11 (8)

***** COMMON/BLK1/N2S, N2L
***** COMMON/BLK2/PS, PL
***** COMMON/BLK3/N1
***** COMMON/BLK4/ALPHA, BETA
***** COMMON/BLK5/PO, PI
***** COMMON/BLK6/C1, C2
***** COMMON/BLK7/SUMLOG(4000)
***** COMMON/BLK8/N
***** COMMON/BLK9/C2MAX, C1MAX(15)
***** COMMON/BLK10/NS, NL
***** COMMON/BLK11/ASN, ASNMAX
***** COMMON/BLK12/OUTFIL
***** ****
***** BEGINNING INITIALIZATION
***** ****
N=0
C2=1000
ASNMIN=15000.
C=-1
***** ****
***** INPUT FORMAT
***** ****
10 WRITE (5,15)
15 FORMAT (///' CODES FOR SELECTING APPR. PROB. DIST. //'
115X, 'BINOMIAL', 12X, '=1',
2/15X, 'POISSON', 13X, '=2')
READ (5,*) K
IF(K.GT.2.OR.K.LT.1) GOTO 10
20 WRITE(5,25)
25 FORMAT(10X, 'SELECT'/16X, 'SAMPLE PLANS ONLY =1'
1/16X, 'ASN VALUES ONLY =2'
2/16X, 'OR BOTH =3')
READ(5,*) KOPT
IF(KOPT.GT.3.OR.KOPT.LT.1) GOTO 20
WRITE (5,30)
30 FORMAT(10X, 'INPUT ALPHA ')
READ (5,*) ALPHA
WRITE (5,35)
35 FORMAT(10X, 'INPUT BETA ')
READ (5,*) BETA

```

MAIN

```
0058
0059      WRITE (5,40)
0060      40 FORMAT(10X, 'INPUT P0 ')
0061      READ (5,*) P0
0062      WRITE (5,45)
0063      45 FORMAT(10X, 'INPUT P1 ')
0064      READ (5,*) P1
0065      WRITE (5,50)
0066      50 FORMAT( 5X, 'INPUT A SEED FOR SINGLE SAMPLING NO. ///'
0067           1'           IF NO SEED AVAILABLE ENTER ZERO AS THE SEED VALUE')
0068      READ(5,*) NS
0069      WRITE(5,55)
0070      55 FORMAT( 5X, 'INPUT A VALUE FOR (R1-C2) ///'
0071           1'           IF R1=C2 THEN THE VALUE WOULD BE 0 ///'
0072           2'           IF R1>C2 THEN THE VALUE WOULD BE A POSITIVE NO. ///'
0073           3'           IF R1<C2 THEN THE VALUE WOULD BE A NEGATIVE NO. ')
0074      READ(5,*) R11
0075
0076      WRITE (1,60)
0077      60 FORMAT('1', //10X, 'DEPT. OF ISE '
0078           1/, 10X, 'UNIVERSITY OF FLORIDA '
0079           2/5X, 5('*'), 'DOUBLE SAMPLING SYSTEM TO MINIMIZE ASN'.
0080           35('*'), 2X, '/')
0081      WRITE (5,65) ALPHA, BETA, P0, P1
0082      WRITE (1,65) ALPHA, BETA, P0, P1
0083      65 FORMAT(//10X, 'ALPHA =', F6.4, 5X, 'BETA =', F6.4,
0084           1/10X, 'P0 =', F6.4, 8X, 'P1 =', F6.4)
0085      WRITE(5,70) R11
0086      WRITE(1,70) R11
0087      70 FORMAT(/5X, 'REJECTION NO. OF FIRST SAMPLE (R1) = C2+(', I3, ')')
0088      MC1=10.0/(P1/P0)
0089      75 C=C+1
0090
C*****SINGLE SAMPLING PROCEDURE BEGINS
0091
C*****COMPUTATION OF LOWER BOUND OF SINGLE SAMPLING PLAN
0092
0093      80 NS=NS+1
0094
C*****COMPUTATION OF UPPER BOUND OF SINGLE SAMPLING PLAN
0095
0096
0097      IF(K.EQ.1) CALL PROBS1(NS, P1, C, BXLEC, N)
0098      IF(K.EQ.2) CALL PROBS2(NS, P1, C, BXLEC, N)
0099      IF(BXLEC.GT.BETA) GOTO 80
0100      NLT=NS-1
0101      NL=MAX0(1, NLT)
0102
C*****COMPUTATION OF UPPER BOUND OF SINGLE SAMPLING PLAN
0103
0104
0105      85 NL=NL+1
0106      IF(K.EQ.1) CALL PROBS1(NL, P0, C, BXLEC)
0107      IF(K.EQ.2) CALL PROBS2(NL, P0, C, BXLEC)
0108      IF(BXLEC.GE.(1-ALPHA)) GOTO 85
0109      NL=NL-1
0110
C*****TEST FOR FEASIBILITY
0111
0112      IF(NS.GT.NL) GOTO 75
0113
0114      WRITE (5,90)
```

MAIN

```
0115      WRITE(1, 70)
0116      70 FORMAT(1, 79X, 'SINGLE SAMPLING PLAN')
0117      WRITE(5, 95) C, NS, NL
0118      WRITE(1, 95) C, NS, NL
0119      95 FORMAT(10X, 'ACCEPTANCE NO. (C) =', I2
0120          1, /10X, 'LOWER BOUND ON N (NS) =', I4
0121          2, /10X, 'UPPER BOUND ON N (NL) =', I4)
0122      ****
0123      C COMPUTATION OF DOUBLE SAMPLING PLAN BEGINS FOR EACH VALUE OF C2
0124      ****
0125      IF(C.LT.C2) MC=C+MC1-1
0126      C2=C
0127      C
0128      R1 C2+R11
0129      C
0130      DO 140 K1 1, C2
0131      C1=K1-1
0132      ****
0133      C CALL SUBROUTINE TO COMPUTE THE FIRST SAMPLE NUMBER
0134      ****
0135      CALL TRY1(NTRY, C1, P1, NS, BETA, K)
0136      N1=NTRY
0137      IF(NTRY.GT.NS) GOTO 145
0138      C
0139      C
0140      WRITE(5, 100)
0141      WRITE(1, 100)
0142      100 FORMAT(10X, 'DOUBLE SAMPLING PLANS', //)
0143      WRITE(5, 105) C1, C2
0144      WRITE(1, 105) C1, C2
0145      C 105 FORMAT(10X, 'FOR C1=', I2, 2X, 'C2=', I2, //)
0146      C
0147      NTEMP=N1
0148      IF(KOPT.EQ.1) WRITE(1, 110)
0149      IF(KOPT.EQ.1) WRITE(5, 110)
0150      IF(KOPT.EQ.2) WRITE(1, 112)
0151      IF(KOPT.EQ.2) WRITE(5, 112)
0152      IF(KOPT.EQ.3) WRITE(5, 115)
0153      IF(KOPT.EQ.3) WRITE(1, 115)
0154      110 FORMAT(11X, '(N1)', 3X, '(N2)', 3X, '(N2L)', 6X, 'PS', 10X, 'PL', //)
0155      111 FORMAT(10X, 'N1', 3X, 'N2', 4X, 'ASNMAX', 6X, 'ASN', //)
0156      112 FORMAT(10X, 'N1', 3X, 'N2', 4X, 'ASNMAX', 6X, 'ASN', //)
0157      113 FORMAT(10X, '(N1)', 3X, '(N2)', 3X, '(N2L)', 4X,
0158          1 'ASNMAX', 6X, 'ASN', //)
0159      NTEMP1=NS
0160      ****
0161      C COMPUTATION OF SECOND SAMPLE FOR EACH VALUE OF FIRST SAMPLE
0162      ****
0163      ASN=FLOAT(NS)*10
0164      DO 135 IZ=NTEMP, NTEMP1
0165      I=IZ
0166      IF ((NTEMP1-I) .LE. (C2*1.5)) GOTO 135
0167      ****
0168      C CALL SUBROUTINE TO COMPUTE SECOND SAMPLE
0169      ****
0170      CALL TRY2(NS, NL, K, I, R1)
0171      IF(KOPT.NE.1) GOTO 125
```

QASN

```
0172      WRITE(1, 120) I, N2S, N2L, PS, PL
0173      WRITE(5, 120) I, N2S, N2L, PS, PL
0174 120      FORMAT(10X, I4, 5X, I4,          N2      ,      14, 4X, F8.6, 4X, F8.6)
0175      GOTO 135
0176  ****
0177  C      TEST FOR FEASIBILITY
0178  ****
0179 125      IF(N2S.GT.N2L) GOTO 135
0180      IF(N2S.LT.(C2-C1).OR.I.LE.C2) GOTO 135
0181      ASNTEM=ASN
0182  ****
0183  C      CALL SUBROUTINE TO COMPUTE ASN(PO) AND ASNMAX VALUES
0184  ****
0185      CALL ASN(ASN, MC, NS, K, I, KOPT, C1MIN, C2MIN, N1MIN, N2MIN, ASNMIN)
0186      IF(KOPT.NE.3) GOTO 135
0187      WRITE(1, 130) I, N2S, N2L, ASNMAX, ASN
0188      WRITE(5, 130) I, N2S, N2L, ASNMAX, ASN
0189 130      FORMAT(10X, I3, 5X, I3, 5X, I3, 4X, 2(F8.4, 3X))
0190      IF(ASN.GT.ASNTEM) GOTO 140
0191 135      CONTINUE
0192
0193  C 140 CONTINUE
0194  C
0195 145      IF(C.LT.MC) GOTO 75
0196      IF(KOPT.EQ.1) GO TO 155
0197      WRITE(1, 150) ASNMIN, N1MIN, N2MIN, C1MIN, C2MIN
0198      WRITE(5, 150) ASNMIN, N1MIN, N2MIN, C1MIN, C2MIN
0199 150      FORMAT(//, 10X, 'GLOBAL MINIMUM ASN(PO)=', F8.2, //
0200      110X, 'CORRESPONDING N1      =', I5//)
0201      210X, 'CORRESPONDING N2S     =', I5//)
0202      310X, 'CORRESPONDING C1      =', I2//)
0203      410X, 'CORRESPONDING C2      =', I2)
0204  C
0205 155      RETURN
0206      END
```

```
0001      SUBROUTINE TRY1(NTRY, C1, P, NL, BETA, K)
0002  ****
0003  C      THIS SUBROUTINE COMPUTES FIRST SAMPLE NUMBER OF DOUBLE
0004  C      SAMPLING PLAN BY AN INTEGER FORM OF BISECTION METHOD
0005  ****
0006      INTEGER C1
0007  C
0008      NLARGE=NL
0009      NSMALL=0
0010  C
0011      10 NTRY=(NSMALL+NLARGE)/2.0
0012  ****
0013  C      CALL APPROPRIATE PROBABILITY SUBROUTINE FOR PROB. CALCULATIONS
0014  ****
0015      15 IF(K.EQ.1) CALL PROBS1(NTRY, P, C1, BXLEC)
0016      IF(K.EQ.2) CALL PROBS2(NTRY, P, C1, BXLFC)
0017      IF(BXLEC.LE.BETA) GOTO 20
0018      NSMALL=NTRY
0019      GOTO 25
0020      20 NLARGE=NTRY
0021      25 IF(NSMALL.NE.(NLARGE-1)) GOTO 10
0022      NTRY=NLARGE
0023      RETURN
0024      END
```

```

0001      SUBROUTINE TRY2(NS, NL, K, J, R1)
0002      **** * **** * **** * **** * **** * **** * **** * ****
0003      C THIS SUBROUTINE COMPUTES THE SECOND SAMPLE NUMBER OF
0004      C THE DOUBLE SAMPLING NUMBER BY AN INTEGER BISECTION
0005      C METHOD. SEVERAL TESTS ARE DONE TO LOCATE THE PARAMETER
0006      C AT ITS TRUE POSITION.
0007      **** * **** * **** * **** * **** * **** * ****
0008      INTEGER C1, C2, R1
0009      C
0010      COMMON/BLK1/N2S, N2L
0011      COMMON/BLK2/PS, PL
0012      COMMON/BLK3/N1
0013      COMMON/BLK4/ALPHA, BETA
0014      COMMON/BLK5/PO, P1
0015      COMMON/BLK6/C1, C2
0016      C
0017      K1=C1+1
0018      **** * **** * **** * **** * **** * **** * ****
0019      C SET LIMITS FOR COMPUTING N2S
0020      **** * **** * **** * **** * **** * **** * ****
0021      NSMALL=NS-J
0022      NLARGE=NSMALL
0023      **** * **** * **** * **** * **** * **** * ****
0024      C INDEXING TO SPECIFY WHAT BOUND (N2S OR N2L)
0025      C IS BEING COMPUTED
0026      **** * **** * **** * **** * **** * **** * ****
0027      I=1
0028      **** * **** * **** * **** * **** * **** * ****
0029      C INITIAL TEST AT EACH LIMIT
0030      **** * **** * **** * **** * **** * **** * ****
0031      CALL PROBD1(J, NSMALL, P1, DPR0B, K, R1)
0032      IF(DPR0B.LE.BETA) GOTO 40
0033      **** * **** * **** * **** * **** * **** * ****
0034      C BISECTION METHOD
0035      **** * **** * **** * **** * **** * **** * ****
0036      NLARGE=NL
0037      10 NTRY=(NSMALL+NLARGE)/2.0
0038      GOTO (15, 20), I
0039      C
0040      15 CALL PROBD1(J, NTRY, P1, DPR0B, K, R1)
0041      IF(DPR0B.LE.BETA) GOTO 30
0042      GOTO 25
0043      20 CALL PROBD1(J, NTRY, PO, DPR0B, K, R1)
0044      IF(DPR0B.LT.(1-ALPHA)) GOTO 30
0045      25 NSMALL=NTRY
0046      GOTO 35
0047      30 NLARGE=NTRY
0048      35 IF((NLARGE-NSMALL).GT.1) GOTO 10
0049      **** * **** * **** * **** * **** * **** * ****
0050      C CHECK THE INDEX TO FIND WHERE THE PROCESS IS
0051      **** * **** * **** * **** * **** * **** * ****
0052      GOTO (40, 45), I
0053      **** * **** * **** * **** * **** * **** * ****
0054      C CHANGE THE INDEX AFTER N2S COMPUTATION
0055      **** * **** * **** * **** * **** * **** * ****
0056      40 I=I+1
0057      **** * **** * **** * **** * **** * **** * ****

```

```

0058      C      TESTING EACH POSSIBLE CASES TO LOCATE
0059      C      THE LOWER BOUND AT ITS TRUE POSITION
0060      C ****
0061      N2S=MAX0(0, NI ARGE)
0062      CALL PROBD1(J, NLARGE, P1, DPROB, K, R1)
0063      PS=DPROB
0064      MTEMP=NLARGE-1
0065      NSMALL=MAX0(0, MTEMP)
0066      NLARGE=NI
0067      GOTO 10
0068      45 N2L=NSMALL
0069      CALL PRORD1(J, NSMALL, PO, DPROB, K, R1)
0070      PL=DPROB
0071      CALL PROBD1(J, NLARGE, PO, DPROB, K, R1)
0072      IF (DPROB.GE. (1-ALPHA)) N2L=NLARGE
0073      IF (DPROB.GE. (1-ALPHA)) PL=DPROB
0074
0075      C 50 RETURN
0076      END

```

```

0001      SUBROUTINE PROBS2(NN, P, C, BXLEC)
0002      C ****
0003      C THIS SUBROUTINE COMPUTES CUMULATIVE POISON
0004      C PROBABILITIES
0005      C ****
0006      INTEGER C
0007      C
0008      PP=P*NN
0009      TERM=1.0
0010      SUM=TERM
0011      C
0012      IF (C.EQ.0) GOTO 15
0013      DO 10 I=1,C
0014          TERM=TERM*PP/I
0015          SUM=SUM+TERM
0016      10 CONTINUE
0017      C
0018      15 BXLEC=SUM/EXP(TPP)
0019      C
0020      RETURN
0021      END

```

```

0001      SUBROUTINE ASN(MC, NS, K, N11, KOPT, C1MIN, C2MIN, N1MIN, N2MIN, ASNMIN)
0002      C***** THIS SUBROUTINE COMPUTES ASN(PO) VALUES AND
0003      C ASNMAX VALUES.
0004      C***** DOUBLE PRECISION SUMLOG
0005      C      INTEGER C1MIN, C2MIN
0006      C
0007      C      COMMON/BLK1/N2S, N2L
0008      C      COMMON/BLK3/N1
0009      C      COMMON/BLK4/ALPHA, BETA
0010      C      COMMON/BLK5/PO, P1
0011      C      COMMON/BLK6/I1, I2
0012      C      COMMON/BLK7/SUMLOG(4000)
0013      C      COMMON/BLK8/N
0014      C      COMMON/BLK11/ASN, ASNMAX
0015      C      COMMON/BLK12/OUTFIL
0016      C***** C
0017      C      INITIALIZATION
0018      C      COMPUTE P* (MAXIMUM PROB. FOR ASNMAX)
0019      C***** C
0020      C      J=11+1
0021      C      XXX=0.0
0022      C      IF(I1.GT.0) XXX=SUMLOG(I1)
0023      C      AKONST=10.**(SUMLOG(I2)+SUMLOG(N11-I2-1)-XXX-SUMLOG(N11-I1-1))
0024      C      TEMP=1.0/FLOAT(I2-I1)
0025      C      AKONST=AKONST**TEMP
0026      C      PSTAR=AKONST/(1.0+AKONST)
0027      C      IF(K.EQ.1) CALL PROBS1(N11, PSTAR, I2, BXLEC)
0028      C      IF(K.EQ.2) CALL PROBS2(N11, PSTAR, I2, BXLEC)
0029      C      TEMP=BXLEC
0030      C      IF(K.EQ.1) CALL PROBS1(N11, PSTAR, I1, BXLEC)
0031      C      IF(K.EQ.2) CALL PROBS2(N11, PSTAR, I1, BXLEC)
0032      C      TEMP1=TEMP-BXLEC
0033      C      TEMP1=TEMP-BXLEC
0034      C      ASNMAX=FLOAT(N11)+N2S*TEMP1
0035      C
0036      C      IF(K.EQ.1) CALL PROBS1(N11, PO, I2, BXLEC)
0037      C      IF(K.EQ.2) CALL PROBS2(N11, PO, I2, BXLEC)
0038      C      TEMP=BXLEC
0039      C      IF(K.EQ.1) CALL PROBS1(N11, PO, I1, BXLEC)
0040      C      IF(K.EQ.2) CALL PROBS2(N11, PO, I1, BXLEC)
0041      C      TEMP2=TEMP-BXLEC
0042      C      ASN=FLOAT(N11)+N2S*TEMP2
0043      C      IF(ASNMAX.GT.NS.OR.ASN.GT.ASNMIN) GOTO 10
0044      C      ASNMIN=ASN
0045      C      N1MIN=N11
0046      C      N2MIN=N2S
0047      C      C1MIN=I1
0048      C      C2MIN=I2
0049      C
0050      C      10 IF(KOPT.NE.2) GOTO 20
0051      C      WRITE(1,15) N11, N2S, ASNMAX, ASN
0052      C      WRITE(5,15) N11, N2S, ASNMAX, ASN
0053      C      15 FORMAT(10X,2(I3,3X),2(F8.4,3X))
0054      C
0055      C      20 RETURN
0056      C      END
0057

```

Program QAFI.FOR

```

0001      C
0002      C*****QUALITY CONTROL PROGRAM TO DERIVE DOUBLE SAMPLING
0003      C      PLANS TO MINIMIZE AVERAGE FRACTION INSPECTED.
0004      C
0005      C
0006      C      PROGRAMMED BY JO ELLEN WALKER
0007      C      DEPARTMENT OF INDUSTRIAL AND SYSTEMS ENGINEERING
0008      C      UNIVERSITY OF FLORIDA
0009      C      GAINESVILLE, FLORIDA 32611
0010      C*****C
0011      C
0012      C      SUBROUTINE QAFI
0013      C      INTEGER C1,C2,C,CSTAR,C2M1
0014      C      INTEGER R1,R1M1
0015      C      DOUBLE PRECISION SUMLOG
0016      C      BYTE OUTFIL(8)
0017      C      COMMON/BLK4/ALPHA,BETA
0018      C      COMMON/BLK6/C1,C2
0019      C      COMMON/BLK7/SUMLOG(4000)
0020      C      COMMON/BLKB/N
0021      C      COMMON/BLK12/OUTFIL
0022      C*****C
0023      C      INPUT PARAMETERS
0024      C*****C
0025      C      KINDEX=1
0026      C      WRITE(5,10)
0027      10 FORMAT(10X,'ENTER VALUE OF ALPHA')
0028      READ(5,*)ALPHA
0029      C      WRITE(5,15)
0030      15 FORMAT(10X,'ENTER VALUE OF P0')
0031      READ(5,*)P0
0032      C      WRITE(5,20)
0033      20 FORMAT(10X,'ENTER AOQL VALUE')
0034      READ(5,*)AOQL
0035      C      WRITE(5,25)
0036      25 FORMAT(10X,'ENTER LOT SIZE')
0037      READ(5,*)NNN
0038      C
0039      C
0040      C
0041      C      WRITE(1,28)
0042      28 FORMAT(1,'//10X,'DEPT. OF ISE '
0043      C      $/,10X,'UNIVERSITY OF FLORIDA '
0044      C      $/5X,5('*'),'DOUBLE SAMPLING SYSTEM TO MINIMIZE AFI',
0045      C      $5('*'),2X,/)
0046      C      WRITE(5,30)ALPHA
0047      C      WRITE(1,30)ALPHA
0048      30 FORMAT(10X,'ALPHA=',2X,F8.6)
0049      C      WRITE(5,35)P0
0050      C      WRITE(1,35)P0
0051      35 FORMAT(10X,'P0=',2X,F8.6)
0052      C      WRITE(5,40)AOQL
0053      C      WRITE(1,40)AOQL
0054      40 FORMAT(10X,'AOQL=',2X,F8.6)
0055      C      WRITE(5,45)NNN
0056      C      WRITE(1,45)NNN
0057      45 FORMAT(10X,'N=',2X,I6)

```

(QAF 1)

```
0058      C*****
0059      C      COMPUTE SINGLE SAMPLING PLAN
0060      C*****
0061      C
0062      C      INITIALIZATION
0063      C
0064      C*****
0065      C      NS=1
0066      C      C=0
0067      C      N=0
0068      C      AFI=1. DO
0069      C
0070      C      WRITE(5, 50)
0071      C      WRITE(1, 50)
0072      50 FORMAT(//10X, '*** SINGLE SAMPLING PLAN ***')
0073      C*****
0074      C      FIND NS, C COMBO THAT SATISFIES L(PO) G.T. 1-ALPHA
0075      C*****
0076      55 CALL PROBS1(NS, PO, C, BXLEC)
0077      IF(BXLEC.LT.(1. DO-ALPHA))C=C+1
0078      IF(BXLEC.LT.(1. DO-ALPHA))NS=C+1
0079      C*****
0080      C      SEARCH TO FIND MIN NS VALUE SUCH THAT AOQL L.T. AOQL*
0081      C*****
0082      60 CALL SEARCH(NNN, C, NS, SAOQ)
0083      IF(SAOQ.LE.AOQL)GOTO 75
0084      NSTEMP=NNN
0085      CALL SEARCH(NNN, C, NSTEMP, SAOQ)
0086      IF(SAOQ.GT.AOQL)C=C+1
0087      C
0088      C
0089      C      IF(SAOQ.GT.AOQL)NS=C+1
0090      C
0091      C
0092      BL=NS
0093      BH=NNN
0094      65 NSTEMP=IIDINT((BL+BH)/2. DO)
0095      CALL SEARCH(NNN, C, NSTEMP, SAOQ)
0096      IF(SAOQ.LE.AOQL)BH=NSTEMP
0097      C
0098      IF(SAOQ.LE.AOQL)AOQ=SAOQ
0099      C
0100      IF(SAOQ.GT.AOQL)BL=NSTEMP
0101      IF((BH-BL).EQ.1. DO)GOTO 70
0102      GOTO 65
0103      70 NS=NSTEMP
0104      IF(SAOQ.GT.AOQL)NS=BH
0105      C*****
0106      C      CHECK THAT NS, C COMBO STILL SATISFIES L(PO) CONSTRAINT
0107      C*****
0108      75 CALL PROBS1(NS, PO, C, BXLEC)
0109      IF(BXLEC.GE.(1. DO-ALPHA))GOTO 80
0110      C      C=C+1
0111      C
0112      C      NS=C+1
0113      C
0114      GOTO 60
```

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0115      C*****
0116      C      COMPUTE AFI
0117      C*****
0118      80 ATIPO=NS*BXLEC+NNN*(1.DO-BXLEC)
0119      AFIPO=ATIPO/NNN
0120      C
0121      NSTAR=NS
0122      C
0123      WRITE(5,85)NS
0124      WRITE(1,85)NS
0125      85 FORMAT(//10X, 'NS=', I3)
0126      WRITE(5,90)C
0127      WRITE(1,90)C
0128      90 FORMAT(10X, 'C=', I2)
0129      WRITE(5,95)AFIPO
0130      WRITE(1,95)AFIPO
0131      95 FORMAT(10X, 'AFI(PO)=', F8.6)
0132      C
0133      100 CSTAR=C
0134      C*****
0135      C      DOUBLE SAMPLING
0136      C*****
0137      C
0138      WRITE(5,105)
0139      WRITE(1,105)
0140      105 FORMAT(//10X, '** DOUBLE SAMPLING PLANS **')
0141      PLAN=1.DO
0142      C2=CSTAR
0143      110 R1=C2+1
0144      C2M1=C2-1
0145      C1PO=C1+1
0146      R1M1=R1-1
0147      DDATT=NNN
0148      TTCTMIN=1.
0149      C
0150      C1=0
0151      JJ=0
0152      C
0153      WRITE(5,115)
0154      WRITE(1,115)
0155      115 FORMAT(//10X, 'C1', 6X, 'C2', 7X, 'N1', 8X, 'N2', 9X, 'AFI', //)
0156      C*****
0157      C      CALCULATE FIRST SAMPLE NUMBER
0158      C
0159      C      FROM RESULTS OF PREVIOUS RUNS, IT WAS FOUND THAT N1 IS NOT LESS
0160      C      THAN NSTAR/8.  THUS, THE INITIAL VALUE OF N1 IS SET ACCORDINGLY.
0161      C*****
0162      C
0163      120 DO 165 LL=INT(NSTAR/8),NSTAR
0164      N1=LL
0165      IF(N1.LT.C2)N1=R1M1
0166      C*****
0167      C      CHECK B(N1,PO,C2) G.T. 1-ALPHA CONSTRAINT
0168      C*****
0169      125 CALL PROBS1(N1,PO,C2,BXLEC)
0170      IF(BXLEC.LT.(1.-ALPHA))GOTO 175
0171      C*****

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0172 C      CALCULATE SECOND SAMPLE
0173 C*****
0174 N2=NSTAR-N1
0175 C*****
0176 C      CHECK THAT DOUBLE PROBABILITY G.T. 1-ALPHA
0177 C*****
0178 130 CALL PROBD1(N1, N2, PO, DPRQB, KINDEX, R1)
0179 IF(DPRQB.GE.(1.-ALPHA))GOTO 135
0180 IF(C1.EQ.C2M1)GOTO 175
0181 C1=C1+1
0182 GOTO 130
0183 C*****
0184 C      FIND N2 VALUE SATISFYING AOQL L.T. AOQL*
0185 C*****
0186 135 CALL SRCH2(NNN, N1, N2, AOQ1)
0187 IF(AOQ1.LE.AOQL)GOTO 150
0188 C*****
0189 C      N2 WILL NOT BE LESS THAN N1*9, THE INITIAL LOWER BOUND ON N2.
0190 C*****
0191 N2TEMP=N1*9
0192 C
0193 CALL SRCH2(NNN, N1, N2TEMP, AOQ1)
0194 IF(AOQ1.GT.AOQL)GOTO 165
0195 C
0196 BL=N2
0197 BH=N1*9
0198 140 N2TEMP=INT((BL+BH)/2)
0199 CALL SRCH2(NNN, N1, N2TEMP, AOQ1)
0200 IF(AOQ1.LE.AOQL)BH=N2TEMP
0201 IF(AOQ1.LE.AOQL)FAOQ=AOQ1
0202 C
0203 IF(AOQ1.GT.AOQL)BL=N2TEMP
0204 IF((BH-BL).EQ.1.)GOTO 145
0205 GOTO 140
0206 145 N2=N2TEMP
0207 IF(AOQ1.GT.AOQL)N2=BH
0208 C*****
0209 C      CHECK THAT BINOMIAL PROBABILITIES ARE G.T. 1-ALPHA
0210 C*****
0211 CALL PROBD1(N1, N2, PO, DPRQB, KINDEX, R1)
0212 IF(DPRQB.LT.(1.-ALPHA))GOTO 165
0213 150 CALL PROBS1(N1, PO, C1, BXLEC)
0214 PA2=DPRQB-BXLEC
0215 C*****
0216 C      COMPUTE ATI
0217 C*****
0218 DATI=N1*DPRQB+N2*PA2+NNN*(1.-DPRQB)
0219 C*****
0220 C      IF THE ATI INCREASES, CONTINUE FOR 5 ADDITIONAL INCREASING
0221 C      ITERATIONS. THEN INCREMENT C1 AND CONTINUE.
0222 C*****
0223 IF(JJ.EQ.4)GOTO 155
0224 IF(DATI.GE.DDATI)JJ=JJ+1
0225 IF(DATI.GE.DDATI)GOTO 165
0226 DDATI=DATI
0227 DDAOQ=FAOQ
0228 C

```

```

0229      K1=C1
0230      K2=C2
0231      K3=N1
0232      K4=N2
0233      C
0234      GOTO 165
0235      C*****
0236      C      MINIMUM OF CELL (TCMIN) FOUND
0237      C*****
0238      155 TCMIN=DDATI/NNN
0239      DDATI=NNN
0240      C
0241      WRITE(5, 160)K1, K2, K3, K4, TCMIN
0242      WRITE(1, 160)K1, K2, K3, K4, TCMIN
0243      160 FORMAT(10X, I2, 6X, I2, 5X, I4, 6X, I4, 7X, F8.6)
0244      C*****
0245      C      IF MINIMUM OF COLUMN IS FOUND, INCREASE C2
0246      C*****
0247      IF(TCMIN.GE.TTCMIN)GOTO 170
0248      KK1=K1
0249      KK2=K2
0250      KK3=K3
0251      KK4=K4
0252      TTCMIN=TCMIN
0253      TTAQ=DDAQ
0254      C
0255      IF (C1.EQ.C2M1) GOTO 175
0256      C1=C1+1
0257      C
0258      JJ=0
0259      N1=KK3
0260      C
0261      GOTO 125
0262      C
0263      165 CONTINUE
0264      C*****
0265      C      MINIMUM OF COLUMN (TMIN) FOUND
0266      C*****
0267      170 TMIN=TTCMIN
0268      TADQ=TTAQ
0269      C*****
0270      C      IF MINIMUM SAMPLING PLAN FOUND, STOP
0271      C*****
0272      IF(TMIN.GE.PLAN)GOTO 190
0273      C
0274      PLAN=TMIN
0275      KKK1=KK1
0276      KKK2=KK2
0277      KKK3=KK3
0278      KKK4=KK4
0279      175 C2=C2+1
0280      C*****
0281      C      NEW BOUNDS ON SAMPLING PLAN CALCULATED FOR NEW VALUE OF C2
0282      C*****
0283      180 CALL SEARCH(NNN, C2, NSTAR, AQ)
0284      IF(AQ.LE.AQ1)GOTO 185
0285      IF(NSTAR.GT.NNN)GOTO 175
0286      NSTAR=NSTAR+1
0287      GOTO 180
0288      C
0289      C
0290      185 CALL PROBS1(NSTAR, PO, C2, BXLEC)
0291      GOTO 110
0292      C
0293      C
0294      190 WRITE(5, 195)
0295      WRITE(1, 195)
0296      195 FORMAT(//10X, 'SAMPLING PLAN MINIMUMS')
0297      WRITE(5, 200)KKK1, KKK2
0298      WRITE(1, 200)KKK1, KKK2
0299      200 FORMAT(//10X, 'C1= ', I2, 2X, 'C2= ', I2)
0300      WRITE(5, 205)KKK3, KKK4
0301      WRITE(1, 205)KKK3, KKK4
0302      205 FORMAT(10X, 'N1= ', I3, 2X, 'N2= ', I3)
0303      WRITE(5, 210)PLAN
0304      WRITE(1, 210)PLAN
0305      210 FORMAT(10X, 'MINIMUM AFI= ', F8.6)
0306      215 RETURN
0307      END

```

```

0001      SUBROUTINE SEARCH(NNN, C, NS, A0Q)
0002      C*****
0003      C  SEARCH TO FIND VALUE OF PSTAR USING GOLDEN
0004      C  SECTION METHOD. INITIAL LIMITS OF 0 AND 1
0005      C*****
0006      INTEGER C
0007      DOUBLE PRECISION SUMLOG
0008      COMMON/BLK7/SUMLOG(4000)
0009      COMMON/BLK8/N
0010      C
0011      A1=0. DO
0012      A2=1. DO
0013      T=1. D-3
0014      R=5. D-1*(DSQRT(5. DO)-1. DO)
0015      H=A2-A1
0016      PLFT=A1+(R*R)*H
0017      PRT=A1+(R*H)
0018      C
0019      C
0020      CALL PROBS1(NS, PLFT, C, BXLEC)
0021      ATI=(NS*BXLEC)+NNN*(1. DO-BXLEC)
0022      AFI1=ATI/NNN
0023      A0Q1=PLFT*(1. DO-AFI1)
0024      CALL PROBS1(NS, PRT, C, BXLEC)
0025      ATI=(NS*BXLEC)+NNN*(1. DO-BXLEC)
0026      AFI2=ATI/NNN
0027      A0Q2=PRT*(1. DO-AFI2)
0028      GOTO 110
0029      C
0030      C
0031      100 CALL PROBS1(NS, PLFT, C, BXLEC)
0032      ATI=(NS*BXLEC)+NNN*(1. DO-BXLEC)
0033      AFI1=ATI/NNN
0034      A0Q1=PLFT*(1. DO-AFI1)
0035      GO TO 110
0036      C
0037      105 CALL PROBS1(NS, PRT, C, BXLEC)
0038      ATI=(NS*BXLEC)+NNN*(1. DO-BXLEC)
0039      AFI2=ATI/NNN
0040      A0Q2=PRT*(1. DO-AFI2)
0041      C
0042      110 IF(A0Q1.LT.A0Q2) GOTO 115
0043      A2=PRT
0044      H=PRT-A1
0045      IF(ABS(PRT-PLFT).LE.T)GOTO 120
0046      C
0047      PRT=PLFT
0048      PLFT=A1+(R*R)*H
0049      A0Q2=A0Q1
0050      GO TO 100
0051      115 A1=PLFT
0052      H=A2-PLFT
0053      C
0054      IF(ABS(PRT-PLFT).LE.T)GOTO 120
0055      PLFT=PRT
0056      PRT=A1+R*H
0057      A0Q1=A0Q2

```

```

0001      SUBROUTINE SRCH2(NNN, N1, N2, A0Q)
0002      C
0003      INTEGER C1, C2, R1
0004      COMMON/BLK6/C1, C2
0005      C
0006      KINDEX=1
0007      A1=0.
0008      A2=1.
0009      T=.0001
0010      R=.5*(DSQRT(5.D0)-1.)
0011      H=A2-A1
0012      PLFT=A1+(R*R)*H
0013      PRT=A1+(R*H)
0014      C
0015      C
0016      CALL PROBS1(N1, PLFT, C1, PA1)
0017      CALL PROBD1(N1, N2, PLFT, DPR0B, KINDEX, R1)
0018      PA2=DPR0B-PA1
0019      ATI=DPR0B*N1+PA2*N2+NNN*(1.-DPR0B)
0020      AFI1=ATI/NNN
0021      A0Q1=PLFT*(1.-AFI1)
0022      CALL PROBS1(N1, PRT, C1, PA1)
0023      CALL PROBD1(N1, N2, PRT, DPR0B, KINDEX, R1)
0024      PA2=DPR0B-PA1
0025      ATI=DPR0B*N1+PA2*N2+NNN*(1.-DPR0B)
0026      AFI2=ATI/NNN
0027      A0Q2=PRT*(1.-AFI2)
0028      GOTO 110
0029      C
0030      C
0031      100 CALL PROBS1(N1, PLFT, C1, PA1)
0032      CALL PROBD1(N1, N2, PLFT, DPR0B, KINDEX, R1)
0033      PA2=DPR0B-PA1
0034      ATI=DPR0B*N1+PA2*N2+NNN*(1.-DPR0B)
0035      AFI1=ATI/NNN
0036      A0Q1=PLFT*(1.-AFI1)
0037      GOTO 110
0038      105 CALL PROBS1(N1, PRT, C1, PA1)
0039      CALL PROBD1(N1, N2, PRT, DPR0B, KINDEX, R1)
0040      PA2=DPR0B-PA1
0041      ATI=DPR0B*N1+PA2*N2+NNN*(1.-DPR0B)
0042      AFI2=ATI/NNN
0043      A0Q2=PRT*(1.-AFI2)
0044      C
0045      C
0046      110 IF(A0Q1.LT.A0Q2)GOTO 115
0047      C
0048      C
0049      A2=PRT
0050      H=PRT-A1
0051      IF(ABS(PRT-PLFT).LE.T)GOTO 120
0052      PRT=PLFT
0053      PLFT=A1+(R*R)*H
0054      A0Q2=A0Q1
0055      GOTO 100
0056      115 A1=PLFT
0057      C
0058      C
0059      H=A2-PLFT
0060      IF(ABS(PRT-PLFT).LE.T)GOTO 120
0061      PLFT=PRT
0062      PRT=A1+R*H
0063      A0Q1=A0Q2
0064      GOTO 105
0065      C
0066      C
0067      120 PS=(PLFT+PRT)/2.
0068      CALL PROBS1(N1, PS, C1, PA1)
0069      CALL PROBD1(N1, N2, PS, DPR0B, KINDEX, R1)
0070      PA2=DPR0B-PA1
0071      AFI=(DPR0B*N1+PA2*N2+NNN*(1.-DPR0B))/NNN
0072      A0Q=PS*(1.-AFI)
0073      RETURN
0074      END

```

Program QMIL.FOR

```

0058      WRITE(1,79)
0059      WRITE(1,79)
0060      79 FORMAT(// 16X  THESE PLACES ARE
0061      ALL CODE
0062      ALL SS
0063      ALL INDEX
0064      ALL VALUES
0065      S=0
0066      IF (RFA.LT.100)THEN
0067      FRR=RFA+1
0068      ENDIF
0069      IF (RAC.LT.100)THEN
0070      RFA=RAC
0071      FRR=RFA+3
0072      ENDIF
0073      IF (RAT.LT.100)THEN
0074      RFA=RAT
0075      FRR=RFA+2
0076      ENDIF
0077      IF (RAE.LT.100)THEN
0078      RFA=RAE
0079      FRR=RFA+5
0080      ENDIF
0081      IF (RAR.LT.100)THEN
0082      RFA=RAR
0083      FRR=RFA+4
0084      ENDIF
0085      IF (TFA.LT.100)THEN
0086      FTR=TFA+1
0087      ENDIF
0088      IF (TAT.LT.100)THEN
0089      TFA=TAT
0090      FTR=TFA+2
0091      ENDIF
0092      IF (TAC.LT.100)THEN
0093      TFA=TAC
0094      FTR=TFA+3
0095      ENDIF
0096      IF (TAR.LT.100)THEN
0097      TFA=TAR
0098      FTR=TFA+4
0099      ENDIF
0100      IF (TAE.LT.100)THEN
0101      TFA=TAE
0102      FTR=TFA+5
0103      ENDIF
0104      IF (NFA.LT.100)THEN
0105      FNR=NFA+1
0106      ENDIF
0107      IF (NAT.LT.100)THEN
0108      NFA=NAT
0109      FNR=NFA+2
0110      ENDIF
0111      IF (NAC.LT.100)THEN
0112      NFA=NAC
0113      FNR=NFA+3
0114      ENDIF

```

```

0115 11 CHAR. L. 100, THER
0116 NIA=NAK
0117 FNR=NAR/4
0118 ENDIF
0119 IF (NAE.LT.100) THEN
0120 NFA=NAI
0121 FNR=NFA/5
0122 ENDIF
0123 IF (NSA.LT.100) THEN
0124 NTN=NSA
0125 SNR=NTN+1
0126 ENDIF
0127 IF (TSA.LT.100) THEN
0128 TN=TSA
0129 STR=TN+1
0130 ENDIF
0131 IF (SC.LT.100) THEN
0132 Z=SC
0133 SRR=Z+3
0134 ENDIF
0135 IF (ST.LT.100) THEN
0136 Z=ST
0137 SRR=Z+2
0138 ENDIF
0139 IF (SR.LT.100) THEN
0140 Z=SR
0141 SRR=Z+4
0142 ENDIF
0143 IF (RFS.GE.L.OR.FS.GE.L.OR.NQ.GE.L.OR.RN.GE.L) THEN
0144
0145 C: THIS SECTION CONTAINS THE FORMAT STATEMENTS
0146 C: NEEDED TO SET UP TABLES FOR THE PLAN STATISTICS
0147 C: AT THE DIFFERENT INSPECTION LEVELS.
0148 C: THE USER IS ASKED IF SCHEME EVALUATION IS
0149 C: DESIRED, IF SO THEN SUBROUTINE DC IS INVOKED.
0150 C: ::::::::::::::::::::::::::::::::::::::::::::::::::::
0151 C
0152 C
0153 WRITE(1,12)
0154 WRITE(5,12)
0155 12 FORMAT(10X, 'USE 100 PERCENT INSPECTION', //, 'AS SAMPLE',
0156      '$', ' SIZE EQUALS OR EXCEEDS LOT SIZE')
0157 S=1
0158 ENDIF
0159 IF (S.EQ.1) GO TO 60
0160 IF ((SP.EQ.'S').OR.(SP.EQ.'D'.AND.CDL.NE.'A')) THEN
0161 WRITE(1,14)
0162 WRITE(5,14)
0163 14 FORMAT(10X, '* NORMAL', //, 'TIGHTENED', //, '*')
0164      '$', 'REDUCED', '*')
0165 WRITE(1,16)
0166 WRITE(5,16)
0167 16 FORMAT(10X, 54(' '))
0168 WRITE(1,10)NFA,TFA,RFA
0169 WRITE(5,10)NFA,TFA,RFA
0170 10 FORMAT(12X, 'AC 1=', I3, 10X, 'AC 1=', I7, 10X, 'AC 1=', I7)
0171      '$', 'WRITE(1,20)FNR,FTR,FRR

```

```

0172      WRITE(5,20)NQ,FRR,FRR
0173 20  FORMAT(12X,'RE 1',I3,10X,'RE 1',I3,10X,'RE 1',I3)
0174      ENDFL
0175      IF(SP.EQ.'D'.AND.CDL.NE.'A')THEN
0176      WRITE(1,25)FS,FS,RFS
0177      WRITE(5,25)FS,FS,RFS
0178 25  FORMAT(12X,'NJ',I5,10X,'NJ',I5,10X,'NJ',I5,10X)
0179      WRITE(1,28)
0180      WRITE(5,28)
0181 28  FORMAT(10X,54(' '))
0182      ENDFL
0183      IF(SP.EQ.'D'.AND.CDL.NE.'A')THEN
0184      WRITE(1,30)NTN,TN,Z
0185      WRITE(5,30)NTN,TN,Z
0186 30  FORMAT(12X,'AC 2',I3,10X,'AC 2',I3,10X,'AC 2',I3,10X)
0187      WRITE(1,40)SNR,STR,SRR
0188      WRITE(5,40)SNR,STR,SRR
0189 40  FORMAT(12X,'RL 2',I3,10X,'RL 2',I3,10X,'RL 2',I3,10X)
0190      WRITE(1,45)FS,FS,RFS
0191      WRITE(5,45)FS,FS,RFS
0192 45  FORMAT(12X,'N2',I5,10X,'N2',I5,10X,'N2',I5,10X)
0193      ENDFL
0194      WRITE(1,48)
0195      WRITE(5,48)
0196 48  FORMAT(10X,54(' '))
0197      IF(SP.EQ.'S')THEN
0198      WRITE(1,50)NQ,NQ,RN
0199      WRITE(5,50)NQ,NQ,RN
0200 50  FORMAT(12X,'N',I6,10X,'N',I10,10X,'N',I10)
0201      WRITE(1,51)
0202      WRITE(5,51)
0203 51  FORMAT(10X,54(' '))
0204      ENDFL
0205      IF((SP.EQ.'D'.AND.CDL.EQ.'A'.AND.J.GE.19).OR.(SP.EQ.'D'.AND.CDL.
0206      $ EQ.'A'.AND.M.LE.16))THEN
0207      WRITE(1,54)
0208      WRITE(5,54)
0209 54  FORMAT(10X,'SAMPLE SIZE NOT AVAILABLE AT ANY INSPECTION',
0210      $ ' LEVEL',/,,'CORRESPONDING SINGLE SAMPLING PLAN WILL',
0211      $ ' BE USED:')
0212      SP='S'
0213      GO TO 1
0214      ENDFL
0215      PRINT*, 'DO YOU WANT SCHEME EVALUATION..?'
0216      PRINT *, 'IF YES ENTER.....1'
0217      PRINT *, 'IF NO ENTER.....2'
0218      READ *,AZ
0219      IF(AZ.EQ.2) GO TO 60
0220      IF(AZ.EQ.1) GO TO 58
0221 58  NNNN=L
0222      IF(SP.EQ.'S') JT=1
0223      IF(SP.EQ.'D') JT=2
0224      CALL OC(NNNN,FS,RFS,RFA,SRR,FRR,NQ,RN,TFA,TN,FTR,STR,NFA,NTN
0225      $ ,FNR,SNR,Z,JT,AQL)
0226 60  RETURN
0227      END

```

```

0001      SUBROUTINE SS
0002
0003      **** THIS SUBROUTINE FINDS THE SAMPLE SIZES FOR
0004      BOTH THE DOUBLE AND THE SINGLE SAMPLING PLANS
0005      AT NORMAL, TIGHTENED AND REDUCED INSPECTION
0006      LEVELS.
0007
0008      ****
0009
0010      CHARACTER 1*2, CDL, SP
0011      INTEGER FS, FA, SA, AR, SR, AC, AT, AE, SC, ST, Z, NN, NFS, NFA, NAE, NSA
0012      INTEGER NAC, NAT, TN, TFS, TFA, TAE, TSA, TAR, TAC, TAT, RN, RFA, RAE
0013      INTEGER RAR, RAC, RAT, NAR, FRR, RFS, FTR, FNR, SNR, STR, SRR
0014      COMMON/SCL/L, SP, S, I, NQ, T, R, CDL, FS, D, J, K, AQL, M, FA, SA, AR
0015      $, SR, AC, AT, AE, SC, ST, Z, NTN, NFS, NFA, NAE, NSA, NAR,
0016      $ NAC, NAT, TN, TFS, TFA, TAE, TSA, TAR, TAC, TAT, RN, RFS, RFA
0017      $, RAE, RAR, RAC, RAT, FRR, FTR, FNR, SNR, STR, SRR
0018      IF (SP.EQ. 'S') THEN
0019          IF (CDL.EQ. 'A') THEN
0020              NQ=2
0021          ENDIF
0022          IF (CDL.EQ. 'B') THEN
0023              NQ=3
0024          ENDIF
0025          IF (CDL.EQ. 'C') THEN
0026              NQ=5
0027          ENDIF
0028          IF (CDL.EQ. 'D') THEN
0029              NQ=8
0030          ENDIF
0031          IF (CDL.EQ. 'E') THEN
0032              NQ=13
0033          ENDIF
0034          IF (CDL.EQ. 'F') THEN
0035              NQ=20
0036          ENDIF
0037          IF (CDL.EQ. 'G') THEN
0038              NQ=32
0039          ENDIF
0040          IF (CDL.EQ. 'H') THEN
0041              NQ=50
0042          ENDIF
0043          IF (CDL.EQ. 'J') THEN
0044              NQ=80
0045          ENDIF
0046          IF (CDL.EQ. 'K') THEN
0047              NQ=125
0048          ENDIF
0049          IF (CDL.EQ. 'L') THEN
0050              NQ=200
0051          ENDIF
0052          IF (CDL.EQ. 'M') THEN
0053              NQ=315
0054          ENDIF
0055          IF (CDL.EQ. 'N') THEN
0056              NQ=500
0057          ENDIF

```

```

0053      IF(CDL.EQ.'P')THEN
0059      NG=800
0060      ENDIF
0061      IF(CDL.EQ.'Q')THEN
0062      NG=1250
0063      ENDIF
0064      IF(CDL.EQ.'R')THEN
0065      NG=2000
0066      ENDIF
0067      IF(CDL.EQ.'S')THEN
0068      NG=3150
0069      ENDIF
0070      IF(CDL.EQ.'A'.OR.CDL.EQ.'B'.OR.CDL.EQ.'C')THEN
0071      RN=2
0072      ENDIF
0073      IF(CDL.EQ.'D') THEN
0074      RN=3
0075      ENDIF
0076      IF(CDL.EQ.'E') THEN
0077      RN=5
0078      ENDIF
0079      IF(CDL.EQ.'F')THEN
0080      RN=8
0081      ENDIF
0082      IF(CDL.EQ.'G')THEN
0083      RN=13
0084      ENDIF
0085      IF(CDL.EQ.'H')THEN
0086      RN=20
0087      ENDIF
0088      IF(CDL.EQ.'J')THEN
0089      RN=32
0090      ENDIF
0091      IF(CDL.EQ.'K')THEN
0092      RN=50
0093      ENDIF
0094      IF(CDL.EQ.'L')THEN
0095      RN=80
0096      ENDIF
0097      IF(CDL.EQ.'M')THEN
0098      RN=125
0099      ENDIF
0100      IF(CDL.EQ.'N')THEN
0101      RN=200
0102      ENDIF
0103      IF(CDL.EQ.'P')THEN
0104      RN=315
0105      ENDIF
0106      IF(CDL.EQ.'Q')THEN
0107      RN=500
0108      ENDIF
0109      IF(CDL.EQ.'R')THEN
0110      RN=800
0111      ENDIF
0112  ENDIF
0113      IF(SP.EQ.'D'.AND.CDL.EQ.'A')THEN
0114      FS=0

```

```

0115      ENDIF
0116      IF (SP.EQ. 'D').AND.(CDL.NE. 'A')THEN
0117          IF (CDL.EQ. 'B')THEN
0118              FS=2
0119          ENDIF
0120          IF (CDL.EQ. 'C')THEN
0121              FS=3
0122          ENDIF
0123          IF (CDL.EQ. 'D')THEN
0124              FS=5
0125          ENDIF
0126          IF (CDL.EQ. 'E')THEN
0127              FS=8
0128          ENDIF
0129          IF (CDL.EQ. 'F')THEN
0130              FS=13
0131          ENDIF
0132          IF (CDL.EQ. 'G')THEN
0133              FS=20
0134          ENDIF
0135          IF (CDL.EQ. 'H')THEN
0136              FS=32
0137          ENDIF
0138          IF (CDL.EQ. 'J')THEN
0139              FS=50
0140          ENDIF
0141          IF (CDL.EQ. 'K')THEN
0142              FS=80
0143          ENDIF
0144          IF (CDL.EQ. 'L')THEN
0145              FS=125
0146          ENDIF
0147          IF (CDL.EQ. 'M')THEN
0148              FS=200
0149          ENDIF
0150          IF (CDL.EQ. 'N')THEN
0151              FS=315
0152          ENDIF
0153          IF (CDL.EQ. 'P')THEN
0154              FS=500
0155          ENDIF
0156          IF (CDL.EQ. 'Q')THEN
0157              FS=800
0158          ENDIF
0159          IF (CDL.EQ. 'R')THEN
0160              FS=1250
0161          ENDIF
0162          IF (CDL.EQ. 'S')THEN
0163              FS=2000
0164          ENDIF
0165      ENDIF
0166      IF ((SP.EQ. 'D').AND.(CDL.EQ. 'B').OR.CDL.EQ. 'C'))THEN
0167          RFS=0
0168      ENDIF
0169      IF (SP.EQ. 'D'.AND.CDL.NE. 'B'.AND.CDL.NE. 'C')THEN
0170          IF (CDL.EQ. 'D')THEN
0171              RFS=2

```

```
0172      ENDIF
0173      IF(CDL.EQ.'E')THEN
0174      RFS=3
0175      ENDIF
0176      IF(CDL.EQ.'F')THEN
0177      RFS=5
0178      ENDIF
0179      IF(CDL.EQ.'G')THEN
0180      RFS=8
0181      ENDIF
0182      IF(CDL.EQ.'H')THEN
0183      RFS=13
0184      ENDIF
0185      IF(CDL.EQ.'J')THEN
0186      RFS=20
0187      ENDIF
0188      IF(CDL.EQ.'K')THEN
0189      RFS=32
0190      ENDIF
0191      IF(CDL.EQ.'L')THEN
0192      RFS=50
0193      ENDIF
0194      IF(CDL.EQ.'M')THEN
0195      RFS=80
0196      ENDIF
0197      IF(CDL.EQ.'N')THEN
0198      RFS=125
0199      ENDIF
0200      IF(CDL.EQ.'P')THEN
0201      RFS=200
0202      ENDIF
0203      IF(CDL.EQ.'Q')THEN
0204      RFS=315
0205      ENDIF
0206      IF(CDL.EQ.'R')THEN
0207      RFS=500
0208      ENDIF
0209
0210
0211      ENDIF
      RETURN
      END
```

```

0001          SUBROUTINE INDEX
0002
0003  C*****
0004  C** THIS SUBROUTINE LOCATES THE CELL IN THE      **
0005  C** TABLES PRESENTED IN MIL-STD-105D CONTAINING   **
0006  C** ACCEPTANCE AND REJECTION NUMBERS FOR ANY      **
0007  C** PARTICULAR COMBINATION OF AQL AND CODE LETTER. **
0008  C*****
0009  C
0010      CHARACTER I*2, CDL, SP
0011      INTEGER FS, FA, SA, AR, SR, AC, AT, AE, SC, ST, Z
0012      COMMON/SCL/L, SP, S, I, NG, T, R, CDL, FS, D, J, K, AQL, M, FA, SA, AR,
0013      $ SR, AC, AT, AE, SC, ST, Z
0014      IF(CDL.EQ.'A')THEN
0015          K=1
0016          ELSE IF(CDL.EQ.'B')THEN
0017              K=2
0018          ELSE IF(CDL.EQ.'C')THEN
0019              K=3
0020          ELSE IF(CDL.EQ.'D')THEN
0021              K=4
0022          ELSE IF(CDL.EQ.'E')THEN
0023              K=5
0024          ELSE IF(CDL.EQ.'F')THEN
0025              K=6
0026          ELSE IF(CDL.EQ.'G')THEN
0027              K=7
0028          ELSE IF(CDL.EQ.'H')THEN
0029              K=8
0030          ELSE IF(CDL.EQ.'J')THEN
0031              K=9
0032          ELSE IF(CDL.EQ.'K')THEN
0033              K=10
0034          ELSE IF(CDL.EQ.'L')THEN
0035              K=11
0036          ELSE IF(CDL.EQ.'M')THEN
0037              K=12
0038          ELSE IF(CDL.EQ.'N')THEN
0039              K=13
0040          ELSE IF(CDL.EQ.'P')THEN
0041              K=14
0042          ELSE IF(CDL.EQ.'Q')THEN
0043              K=15
0044          ELSE IF(CDL.EQ.'R')THEN
0045              K=16
0046          ELSE IF(CDL.EQ.'S')THEN
0047              K=17
0048          ENDIF
0049          IF(AQL.EQ.0.010)THEN
0050              J=1
0051          ELSE IF(AQL.EQ.0.015)THEN
0052              J=2
0053          ELSE IF(AQL.EQ..025)THEN
0054              J=3
0055          ELSE IF(AQL.EQ.0.040)THEN
0056              J=4
0057          ELSE IF(AQL.EQ.0.065)THEN

```

0058 J=5 IF (AQL . EQ. 0. 10) THEN
0059 J=6 ELSE IF (AQL . EQ. 0. 15) THEN
0060 J=7 ELSE IF (AQL . EQ. 0. 25) THEN
0061 J=8 ELSE IF (AQL . EQ. 0. 4) THEN
0062 J=9 ELSE IF (AQL . EQ. 0. 65) THEN
0063 J=10 ELSE IF (AQL . EQ. 1) THEN
0064 J=11 ELSE IF (AQL . EQ. 1. 5) THEN
0065 J=12 ELSE IF (AQL . EQ. 2. 5) THEN
0066 J=13 ELSE IF (AQL . EQ. 4) THEN
0067 J=14 ELSE IF (AQL . EQ. 6. 5) THEN
0068 J=15 ELSE IF (AQL . EQ. 10) THEN
0069 J=16 ELSE IF (AQL . EQ. 15) THEN
0070 J=17 ELSE IF (AQL . EQ. 25) THEN
0071 J=18 ELSE IF (AQL . EQ. 40) THEN
0072 J=19 ELSE IF (AQL . EQ. 65) THEN
0073 J=20 ELSE IF (AQL . EQ. 100) THEN
0074 J=21 ELSE
0075 J=22
0076 ENDIF
0077 M=J+K
0078 RETURN
0079 END

```

0001      SUBROUTINE VALUES
0002
0003      C
0004      C*** THIS SUBROUTINE FINDS ACCEPTANCE AND REJECTION ***
0005      C** NUMBERS FOR THE CELL IDENTIFIED BY SUBROUTINE INDEX. ***
0006      C
0007      C
0008      CHARACTER 1*2, CDL, SP
0009      INTEGER FS, FA, SA, AR, SR, AC, AT, AE, SC, ST, Z, NN, NFS, NFA, NAE, NSA
0010      INTEGER NAR, NAC, NAT, TN, TFS, TFA, TAE, TAR, TAC, TAT, RN, RFA, RAE
0011      INTEGER FRR, FTR, FNR, SNR, STR, SRR, RAR, RAC, RAT, RFS, TSA
0012      COMMON/SCL/L, SP, S, I, NQ, T, R, CDL, FS, D, J, K, AQL, M, FA, SA,
0013      $ AR, SR, AC, AT, AE, SC, ST, Z, NTN, NFS, NFA, NAE, NSA, NAR, NAC, NAT, TN
0014      $ , TFS, TFA, TAE, TSA, TAR, TAC, TAT, RN, RFS, RFA, RAE, RAR, RAC, RAT
0015      $ , FRR, FTR, FNR, SNR, STR, SRR
0016      NFA=100
0017      TFA=100
0018      RFA=100
0019      NAT=100
0020      TAT=100
0021      RAT=100
0022      TAC=100
0023      RAC=100
0024      TAR=100
0025      RAR=100
0026      TAE=100
0027      RAE=100
0028      TSA=100
0029      NAC=100
0030      NAR=100
0031      NAE=100
0032      NSA=100
0033      ST=100
0034      SC=100
0035      SR=100
0036      IF(SP.EQ.'S')THEN
0037      IF(M.GE.2.AND.M.LE.16)NFA=0
0038      IF(M.GE.26)NFA=21
0039      IF(M.EQ.25)NFA=14
0040      IF(M.EQ.24)NFA=10
0041      IF(M.EQ.23)NFA=7
0042      IF(M.EQ.22)NFA=5
0043      IF(M.EQ.21)NFA=3
0044      IF(M.EQ.20)NFA=2
0045      IF(M.EQ.19)NFA=1
0046      IF(M.EQ.17.AND.J.NE.16)NFA=0
0047      IF(M.EQ.18.AND.J.NE.18)NFA=1
0048      IF(K.EQ.16.AND.J.LE.2)NFA=0
0049      IF(J.EQ.16.AND.K.LE.2)NFA=1
0050      IF(M.GE.26)TFA=18
0051      IF(M.EQ.25)TFA=12
0052      IF(M.EQ.24)TFA=8
0053      IF(M.EQ.23)TFA=5
0054      IF(M.EQ.22)TFA=3
0055      IF(M.EQ.21)TFA=2
0056      IF(M.GE.18.AND.M.LE.20.AND.J.NE.16)TFA=1
0057      IF(K.EQ.16.AND.J.EQ.2)TFA=2

```

```

0058      IF (M.LE.17.AND.J.LE.10)TFA=0
0059      IF (J.EQ.16.AND.K.LE.2)TFA=1
0060      IF (M.GE.26)RAC=10
0061      IF (M.EQ.25)RAC=7
0062      IF (M.EQ.24)RAC=5
0063      IF (M.EQ.23)RAC=3
0064      IF (M.EQ.22.AND.J.LE.19)RAC=2
0065      IF (M.EQ.21)RAC=1
0066      IF (M.EQ.20.AND.J.LE.18)RAT=1
0067      IF (M.EQ.19.AND.J.LE.17)RAT=0
0068      IF (M.GE.2.AND.M.LE.16)RFA=0
0069      IF (M.EQ.17.AND.J.LE.15)RFA=0
0070      IF (J.LE.2)RFA=0
0071      IF (J.EQ.16.AND.K.LE.3)RAT=0
0072      IF (J.EQ.17.AND.K.EQ.1)RAT=0
0073      IF (J.EQ.21.AND.K.LE.2)RFA=5
0074      IF (J.EQ.20.AND.K.EQ.1)RFA=3
0075      IF (J.EQ.20.AND.K.EQ.2)RAT=3
0076      IF (J.EQ.19.AND.K.EQ.1)RFA=2
0077      IF (J.EQ.19.AND.K.EQ.2)RAT=2
0078      IF (J.EQ.18.AND.K.EQ.1)RFA=1
0079      IF (J.EQ.18.AND.K.EQ.2)RAT=1
0080      ENDIF
0081      IF (SP.EQ.'D')THEN
0082          IF (M.LE.16.AND.J.LE.15)THEN
0083              NAT=0
0084              NSA=1
0085              TAT=0
0086              TSA=1
0087              RAT=0
0088              ST=0
0089          END IF
0090          IF (K.EQ.16.AND.J.LE.2)THEN
0091              NAT=0
0092              NSA=1
0093              TAT=0
0094              TSA=1
0095              RAT=0
0096              ST=0
0097          ENDIF
0098          IF (K.EQ.1.AND.J.EQ.18)THEN
0099              NSA=3
0100              NAC=0
0101              TAT=0
0102              TSA=1
0103          ENDIF
0104          IF (M.GE.26)THEN
0105              NAE=11
0106              NSA=26
0107          ENDIF
0108          IF (M.EQ.25)THEN
0109              NAR=7
0110              NSA=18
0111          ENDIF
0112          IF (M.EQ.24)THEN
0113              NAR=5
0114              NSA=12

```

VALUES:

```
0115      ENDIF
0116      IF (M. EQ. 23) THEN
0117      NAR=3
0118      NSA=8
0119      ENDIF
0120      IF (M. EQ. 22) THEN
0121      NAC=2
0122      NSA=6
0123      ENDIF
0124      IF (M. EQ. 21) THEN
0125      NAC=1
0126      NSA=4
0127      ENDIF
0128      IF (M. EQ. 20) THEN
0129      NAC=0
0130      NSA=3
0131      ENDIF
0132      IF ((M. EQ. 19. AND. J. GT. 2). OR. (M. EQ. 18. AND. J. GT. 2)) THEN
0133      NAT=0
0134      NSA=1
0135      ENDIF
0136      IF (J. EQ. 16. AND. K. LE. 3) THEN
0137      NAT=0
0138      NSA=1
0139      ENDIF
0140      IF (M. GE. 26) THEN
0141      TAE=9
0142      TSA=23
0143      ENDIF
0144      IF (M. EQ. 25) THEN
0145      TAR=6
0146      TSA=15
0147      ENDIF
0148      IF (M. EQ. 24) THEN
0149      TAR=3
0150      TSA=11
0151      ENDIF
0152      IF (M. EQ. 23) THEN
0153      TAC=2
0154      TSA=6
0155      ENDIF
0156      IF (M. EQ. 22) THEN
0157      TAC=1
0158      TSA=4
0159      ENDIF
0160      IF (M. EQ. 21) THEN
0161      TAC=0
0162      TSA=3
0163      ENDIF
0164      IF (M. GE. 18. AND. M. LE. 20. AND. J. GE. 3) THEN
0165      TAT=0
0166      TSA=1
0167      ENDIF
0168      IF (M. EQ. 26) THEN
0169      RAE=5
0170      SR=12
0171      ENDIF
```

```
0172      IF (M, EQ. 25) THEN
0173      RAE=3
0174      SR=8
0175      ENDIF
0176      IF (M, EQ. 24) THEN
0177      RAE=2
0178      SC=6
0179      ENDIF
0180      IF (M, EQ. 23) THEN
0181      RAR=1
0182      SC=4
0183      ENDIF
0184      IF (M, EQ. 22) THEN
0185      RAR=0
0186      SC=3
0187      ENDIF
0188      IF (M, EQ. 21) THEN
0189      RAR=0
0190      SR=1
0191      ENDIF
0192      IF (M, EQ. 20) THEN
0193      RAC=0
0194      SR=0
0195      ENDIF
0196      IF (M, EQ. 19) THEN
0197      RAT=0
0198      ST=0
0199      ENDIF
0200      IF (M, EQ. 18, AND, J, GE, 3, AND, J, LE, 15) THEN
0201      RAT=0
0202      ST=0
0203      ENDIF
0204      ENDIF
0205      RETURN
0206      END
```

```

0001      SUBROUTINE CODE
0002
0003      C*****
0004      C** THIS SUBROUTINE IDENTIFIES THE CODE LETTER ASSOCIATED  **
0005      C** WITH EITHER THE SPECIAL OR GENERAL INSPECTION LEVELS  **
0006      C** FOR ANY GIVEN LOT OR BATCH SIZE.                         **
0007      C*****
0008      C
0009      CHARACTER I*2, CDL, SP
0010      INTEGER S1, S2, S3, S4
0011      COMMON/SCL/L, SP, S, I, NG, T, R, CDL
0012      IF(I.EQ.'S1')THEN
0013          IF(L.GE. 2.AND.L.LE.50)CDL='A'
0014          IF(L.GE.51.AND.L.LE.500)CDL='B'
0015          IF(L.GE.501.AND.L.LE.35000)CDL='C'
0016          IF(L.GE.35001)CDL='D'
0017      ENDIF
0018      IF(I.EQ.'S2')THEN
0019          IF(L.GE. 2.AND.L.LE.25)CDL='A'
0020          IF(L.GE.26.AND.L.LE.150)CDL='B'
0021          IF(L.GE.151.AND.L.LE.1200)CDL='C'
0022          IF(L.GE.1201.AND.L.LE.35000)CDL='D'
0023          IF(L.GE.35001)CDL='E'
0024      ENDIF
0025      IF(I.EQ.'S3')THEN
0026          IF(L.GE. 2.AND.L.LE.15)CDL='A'
0027          IF(L.GE.26.AND.L.LE.50)CDL='B'
0028          IF(L.GE.51.AND.L.LE.150)CDL='C'
0029          IF(L.GE.151.AND.L.LE.500)CDL='D'
0030          IF(L.GE.501.AND.L.LE.3200)CDL='E'
0031          IF(L.GE.3201.AND.L.LE.35000)CDL='F'
0032          IF(L.GE.35001.AND.L.LE.500000)CDL='G'
0033          IF(L.GE.500001)CDL='H'
0034      ENDIF
0035      IF(I.EQ.'S4')THEN
0036          IF(L.GE. 2.AND.L.LE.15)CDL='A'
0037          IF(L.GE.16.AND.L.LE.25)CDL='B'
0038          IF(L.GE.26.AND.L.LE.90)CDL='C'
0039          IF(L.GE.91.AND.L.LE.150)CDL='D'
0040          IF(L.GE.151.AND.L.LE.500)CDL='E'
0041          IF(L.GE.501.AND.L.LE.1200)CDL='F'
0042          IF(L.GE.1201.AND.L.LE.10000)CDL='G'
0043          IF(L.GE.10001.AND.L.LE.35000)CDL='H'
0044          IF(L.GE.35001.AND.L.LE.500000)CDL='J'
0045          IF(L.GT.500000)CDL='K'
0046      ENDIF
0047      IF(I.EQ.'1')THEN
0048          IF(L.GE. 2.AND.L.LE.15)CDL='A'
0049          IF(L.GE.16.AND.L.LE.25)CDL='B'
0050          IF(L.GE.26.AND.L.LE.90)CDL='C'
0051          IF(L.GE.91.AND.L.LE.150)CDL='D'
0052          IF(L.GE.151.AND.L.LE.280)CDL='E'
0053          IF(L.GE.281.AND.L.LE.500)CDL='F'
0054          IF(L.GE.501.AND.L.LE.1200)CDL='G'
0055          IF(L.GE.1201.AND.L.LE.3200)CDL='H'
0056          IF(L.GE.3201.AND.L.LE.10000)CDL='J'
0057          IF(L.GE.10001.AND.L.LE.35000)CDL='K'

```

```

0058 IF (L.GE. 35001.AND.L.LE.150000)CDL='L'
0059 IF (L.GE. 150001.AND.L.LE.500000)CDL='M'
0060 IF (L.GE. 500001)CDL='N'
0061 ENDIF
0062 IF (I.EQ.'2')THEN
0063 IF (L.GE. 2.AND.L.LE.8)CDL='A'
0064 IF (L.GE. 9.AND.L.LE.15)CDL='B'
0065 IF (L.GE. 16.AND.L.LE.25)CDL='C'
0066 IF (L.GE. 26.AND.L.LE.50)CDL='D'
0067 IF (L.GE. 51.AND.L.LE.90)CDL='E'
0068 IF (L.GE. 91.AND.L.LE.150)CDL='F'
0069 IF (L.GE. 151.AND.L.LE.280)CDL='G'
0070 IF (L.GE. 281.AND.L.LE.500)CDL='H'
0071 IF (L.GE. 501.AND.L.LE.1200)CDL='J'
0072 IF (L.GE. 1201.AND.L.LE.3200)CDL='K'
0073 IF (L.GE. 3201.AND.L.LE.10000)CDL='L'
0074 IF (L.GE. 10001.AND.L.LE.35000)CDL='M'
0075 IF (L.GE. 35001.AND.L.LE.150000)CDL='N'
0076 IF (L.GE. 150001.AND.L.LE.500000)CDL='P'
0077 IF (L.GE. 500001)CDL='Q'
0078 ENDIF
0079 IF (I.EQ.'3')THEN
0080 IF (L.GE. 2.AND.L.LE.8)CDL='B'
0081 IF (L.GE. 9.AND.L.LE.15)CDL='C'
0082 IF (L.GE. 16.AND.L.LE.25)CDL='D'
0083 IF (L.GE. 26.AND.L.LE.50)CDL='E'
0084 IF (L.GE. 51.AND.L.LE.90)CDL='F'
0085 IF (L.GE. 91.AND.L.LE.150)CDL='G'
0086 IF (L.GE. 151.AND.L.LE.280)CDL='H'
0087 IF (L.GE. 281.AND.L.LE.500)CDL='J'
0088 IF (L.GE. 501.AND.L.LE.1200)CDL='K'
0089 IF (L.GE. 1201.AND.L.LE.3200)CDL='L'
0090 IF (L.GE. 3201.AND.L.LE.10000)CDL='M'
0091 IF (L.GE. 10001.AND.L.LE.35000)CDL='N'
0092 IF (L.GE. 35001.AND.L.LE.150000)CDL='P'
0093 IF (L.GE. 150001.AND.L.LE.500000)CDL='Q'
0094 IF (L.GE. 500001)CDL='R'
0095 ENDIF
0096 RETURN
0097 END

```

```

0001      SUBROUTINE OC(NNNN, IFS, IRFS, IRFA, ISRR, IFRR, NG, IRN, ITFA
0002      & ITN, ITTR, ISTR, NFA, NTN, IFNR, ISNR, IZ, J, AQL)
0003
0004      ****
0005      ** THIS SUBROUTINE EVALUATES THE SCHEME OPERATING
0006      ** CHARACTERISTICS, FOR THE REQUIRED SAMPLING PLANS.
0007      ****
0008
0009      REAL*8 AQ(20, 20), BQ(20, 20)
0010      DIMENSION N(30), PR(30), V(100, 50), P(30), TPA(30, 4), ASN(30, 4)
0011      DIMENSION AQG(30, 4), ATI(30, 4), NN(4), TM(20, 20), ZP(20, 20)
0012      DIMENSION ASNC(30), AQQC(30), ATIC(30), AFI(30), PA(30)
0013      INTEGER A(50), R(50), HI, AA(2, 4), RR(2, 4)
0014      IF (J.EQ.2) GO TO 197
0015      IF (J.EQ.1) GO TO 172
0016      172
0017      NN(1)=NG
0018      NN(2)=NG
0019      NN(3)=IRN
0020      NN(4)=IRN
0021      AA(1, 4)=IFRR-1
0022      RR(1, 3)=IRFA+1
0023      GO TO 272
0024      197
0025      NN(1)=IFS
0026      NN(2)=IFS
0027      NN(3)=IRFS
0028      NN(4)=IRFS
0029      AA(1, 4)=IRFA
0030      AA(2, 4)=ISRR-1
0031      RR(1, 3)=IFRR
0032      272
0033      AA(1, 1)=ITFA
0034      AA(2, 1)=ITN
0035      RR(1, 1)=IFTR
0036      RR(2, 1)=ISTR
0037      AA(1, 2)=NFA
0038      AA(2, 2)=NTN
0039      RR(1, 2)=IFNR
0040      RR(2, 2)=ISNR
0041      AA(1, 3)=IRFA
0042      AA(2, 3)=IZ
0043      RR(1, 3)=IZ+1
0044      RR(2, 3)=IZ+1
0045      RR(1, 4)=IFRR
0046      RR(2, 4)=ISRR
0047      PRINT *, 'DO YOU WANT A TABLE OR A GRAPH FORMAT ?'
0048      PRINT *, 'FOR GRAPH...ENTER: 1'
0049      PRINT *, 'FOR TABLE...ENTER: 2'
0050      READ *, XTC
0051      IF (XTC.EQ.1) GO TO 733
0052      PRINT *, 'SPECIFY THE NUMBER OF FRACTION DEFECTIVE VALUES..'
0053      READ *, J1
0054      PRINT *, 'ENTER THE FRACTION DEFECTIVE VALUE(S).'
0055      PRINT *, '(PUT A COMMA BETWEEN VALUES.).....'
0056      READ *, (P(I), I=1, J1)
0057      WRITE(1, 27)
0058      WRITE(5, 27)
0059      GO TO 447
0060      733
0061      J1=21
0062      DO 55 I=1, J1

```

```

0058      P(I)=A(I-1)/20.0
0059      P(I)=P(I)/10.0
0060      44  DO 105 I=1,J1
0061      DO 10 I=M 1,4
0062      DU 17 J=1,J
0063      A(I)=AA(I,1,M)
0064      R(I)=RR(I,1,M)
0065      N(I)=NN(I,M)
0066      17  CONTINUE
0067      NNN=NNNN
0068      M=INT(NNN*P(L))
0069      ZNK=NNN*P(L)
0070      ZN=M
0071      IF(ZNK-ZN.LE.0.5) GO TO 148
0072      M=M+1
0073      148  CONTINUE
0074      SUM=0
0075      I1=R(1)
0076
0077      C
0078      C THE NEXT STATEMENTS CALCULATE THE PROBABILITY THAT
0079      C THERE ARE (I-1) DEFECTIVES IN THE FIRST SAMPLE.
0080      C
0081      C
0082      DO 20 J=1,11
0083      V(I,1)=PP(N(1),P(L),I-1)
0084      20  SUM=SUM+V(I,1)
0085      V(R(1)+1,1)=1.-SUM
0086      IF(A(1).LE.0) GO TO 21
0087      I1=A(1)
0088
0089      C
0090      C THE FOLLOWING STATEMENTS CALCULATE THE PROB. THAT THERE
0091      C ARE LESS THAN OR EQUAL TO A(1) DEFECTIVE ITEMS.
0092      C
0093      C
0094      DO 30 I=1,11
0095      C
0096      C
0097      C THE NEXT SECTION CALCULATES THE INTERMEDIATE PROBABILITIES
0098      C OF CONTINUED SAMPLING FOR THE DOUBLE SAMPLING PLANS.
0099      C
0100      C
0101      C
0102      30  V(A(1)+1,1)=V(A(1)+1,1)+V(I,1)
0103      21  IF(J.EQ.1) GO TO 41
0104      LOW =1
0105      I=2
0106      NNN=NNN-N(I-1)
0107      NR=R(I)
0108      LOW=MAX0(LOW,A(I-1)+2)
0109      HI=R(I-1)
0110      DO 60 I1=1, NR
0111      V(I1,I)=0
0112      IF(I1.LT.LOW) GO TO 60
0113      IF(A(I).EQ.(-1)) GO TO 61
0114      IF(A(I)+1.NE.I1) GO TO 61

```

```

0115      MMM=MINO(I1,HI)
0116      DO 70 I2=LOW , MMM
0117      I4=I1+I2+1
0118      DO 50 I1=1, NR
0119      PR(I1)=PP(N(I), P(L), I1-1, NNN, M, I2+1)
0120      50  CONTINUE
0121      DO 80 I3=1, I4
0122      80  V(I1, I)=V(I1, I)+V(I2, I-1)*PR(I3)
0123      70  CONTINUE
0124      GO TO 60
0125      61  MMM=MINO(HI, I1)
0126      DO 90 I2=LOW , MMM
0127      I3=I1-I2+1
0128      DO 743 IJ=1, NR
0129      743  PR(IJ)=PP(N(I), P(L), IJ-1)
0130      90  V(I1, I)=V(I1, I)+V(I2, I-1)*PR(I3)
0131      60  CONTINUE
0132      V(R(I)+1, I)=0
0133      DO 110 I1=LOW , HI
0134      SUM=0
0135      I3=R(I)-I1+1
0136      DO 120 I2=1, I3
0137      120  SUM=SUM+PR(I2)
0138      110  V(R(I)+1, I)=V(R(I)+1, I)+(1.-SUM)*V(I1, I-1)
0139      41  CONTINUE
0140
C
0141 C THE NEXT SECTION EVALUATES THE SCHEME FOR THE SINGLE
0142 C SAMPLING PLAN (OR THE FIRST STAGE IN DOUBLE SAMPLING).
0143 C
0144 C
0145 C
0146 121  ASN(L, LM)=0
0147  TPA(L, LM)=0
0148  SS=0
0149  DO 130 I=1, J
0150  SS=SS+N(I)
0151  IF(A(I).EQ.(-1)) GO TO 131
0152  ASN(L, LM)=ASN(L, LM)+(V(A(I)+1, I)+V(R(I)+1, I))*SS
0153  TPA(L, LM)=TPA(L, LM)+V(A(I)+1, I)
0154  GO TO 130
0155  131  ASN(L, LM)=ASN(L, LM)+V(R(I)+1, I)*SS
0156  130  CONTINUE
0157  XXX=0
0158  SSS=0
0159  VVV=0
0160  DO 133 I=1, J
0161  SSS=SSS+N(I)
0162  XXX=XXX+SSS*V(A(I)+1, I)
0163  VVV=VVV+(NNNN-SSS)*V(A(I)+1, I)
0164  133  CONTINUE
0165  ATI(L, LM)=XXX+(NNNN*(1.0-TPA(L, LM)))
0166  A0Q(L, LM)=(VVV*P(L))/NNNN
0167  140  CONTINUE
0168  10  CONTINUE
0169  19  FORMAT(10X, F5.3, 2X, F9.4, F10.2, 4X, F6.4, 1X, F10.2)
0170  27  FORMAT(//, 16X, 'SCHEME OPERATING CHARACTERISTICS ', //, 10X
0171      $ , 'P: ', ASN, ' A0Q: ', A0Q, ' AFI: ', AFI)

```

```

0172      DO 1 1 1, 20
0173      DO 1 10, 1, 20
0174      TM(1, 10) = 0
0175
0176
0177      C THIS SECTION FIRST CALCULATES THE PROB. OF BEING
0178      C IN NORMAL, TIGHTENED OR REDUCED INSPECTION LEVELS AND
0179      C THEN COMPUTES THE PROB. OF PASSING THE LIMIT NUMBER
0180      C CRITERIA.
0181      C
0182      C
0183      T=TPA(L, 1)
0184      S=TPA(L, 2)
0185      RR1=TPA(L, 3)
0186      R1=TPA(L, 4)
0187      NZ=10*ASN(L, 2)
0188      CALL LNM(AQL, NZ, LNC)
0189      Q=B(NZ, P(L), LNC)
0190
0191
0192      C THIS SECTION READS IN THE PROBABILITY TRANSITION MATRIX.
0193      C
0194      C
0195      TM(1, 1)=1. -T
0196      TM(1, 2)=T
0197      TM(2, 1)=1. -T
0198      TM(2, 3)=T
0199      TM(3, 1)=1. -T
0200      TM(3, 4)=T
0201      TM(4, 1)=1. -T
0202      TM(4, 5)=T
0203      TM(5, 1)=1. -T
0204      TM(5, 6)=T
0205      TM(6, 7)=1. -S
0206      TM(6, 11)=S
0207      TM(7, 1)=1. -S
0208      TM(7, 8)=S
0209      TM(8, 1)=1. -S
0210      TM(8, 9)=S
0211      TM(9, 1)=1. -S
0212      TM(9, 10)=S
0213      TM(10, 1)=1. -S
0214      TM(10, 14)=S
0215      TM(11, 7)=1. -S
0216      TM(11, 12)=S
0217      TM(12, 7)=1. -S
0218      TM(12, 13)=S
0219      TM(13, 7)=1. -S
0220      TM(13, 14)=S
0221      TM(14, 7)=1. -S
0222      TM(14, 15)=S
0223      TM(15, 7)=1. -S
0224      TM(15, 16)=S
0225      TM(16, 7)=1. -S
0226      TM(16, 17)=S
0227      TM(17, 7)=1. -S
0228      TM(17, 18)=S

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```

0237      TM(16,7)=1.0
0238      TM(18,19)=0
0239      TM(19,7)=1.0
0240      TM(19,19)=(1.-Q)*S
0241      TM(19,20)=Q*S
0242      TM(20,6)=1.-RR1
0243      TM(20,20)=RR1
0244      NR=20
0245      NC=20
0246      DO 100 I=1, NR
0247      DO 100 JJ=1, NC
0248      IF (JJ-I)111,15,111
0249      15      ZP(JJ, I)=TM(I, JJ)-1.0
0250      GO TO 100
0251      100      ZP(JJ, I)=TM(I, JJ)
0252      CONTINUE
0253      DO 115 I=2, NR
0254      DO 115 JJ=1, NC
0255      KL=I-1
0256      AQ(I, JJ)=ZP(KL, JJ)
0257      CONTINUE
0258      DO 115 JJ=1, NC
0259      AQ(1, JJ)=1.0
0260      CONTINUE
0261      CALL INVERT(NR, AQ, BQ)
0262      PA(L)=0
0263      ASNC(L)=0
0264      AQQC(L)=0
0265      ATIC(L)=0
0266      DO 161 I=1, NR
0267      IF(I.GT.5)GO TO 200
0268      ZZ=T
0269      Z1=ASN(L, 1)
0270      Z2=A0Q(L, 1)
0271      Z3=ATI(L, 1)
0272      GO TO 201
0273      200      IF(I.GT.19) GO TO 210
0274      ZZ=S
0275      Z1=ASN(L, 2)
0276      Z2=A0Q(L, 2)
0277      Z3=ATI(L, 2)
0278      GO TO 201
0279      210      ZZ=R1
0280      Z1=ASN(L, 4)
0281      Z2=A0Q(L, 4)
0282      Z3=ATI(L, 4)
0283      C
0284      C   THE FOLLOWING STATEMENTS MULTIPLY THE PROBABILITIES
0285      C   OF BEING IN THE VARIOUS STATES BY THE CHARACTERISTICS
0286      C   OF EACH STATE.
0287      C
0288      201      PA(L)=PA(L)+BQ(I, 1)*ZZ
0289      ASNC(L)=ASNC(L)+BQ(I, 1)*Z1
0290      AQQC(L)=AQQC(L)+BQ(I, 1)*Z2
0291      ATIC(L)=ATIC(L)+BQ(I, 1)*Z3

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```

0286      AFI(L)=ATJC(L)/NNNN
0287      161  CONTINUE
0288      IF(XTC.NE.2) GO TO 101
0289          WRITE(1,19) P(L),PA(L),ASNC(L),AOQC(L),AFI(L)
0290          WRITE(5,19) P(L),PA(L),ASNC(L),AOQC(L),AFI(L)
0291      101  CONTINUE
0292      IF(XTC.EQ.2) GO TO 556
0293          WRITE(1,45)
0294          WRITE(5,45)
0295          WRITE(1,46)
0296          WRITE(5,46)
0297          CALL PLOTDC(P,PA)
0298          WRITE(1,47)
0299          WRITE(5,47)
0300          CALL PLOTDC(P,ASNC)
0301          WRITE(1,48)
0302          WRITE(5,48)
0303          CALL PLOTDC(P,AOQC)
0304          WRITE(1,49)
0305          WRITE(5,49)
0306          CALL PLOTDC(P,AFI)
0307      45      FORMAT(1H1,50X,'OPERATING CHARACTERISTIC CURVE')
0308      46      FORMAT(53X,'PROBABILITY OF ACCEPTANCE')
0309      47      FORMAT(1H1,50X,'AVERAGE SAMPLE NUMBER')
0310      48      FORMAT(1H1,50X,'AVERAGE OUTGOING QUALITY')
0311      49      FORMAT(1H1,50X,'AVERAGE FRACTION INSPECTED')
0312          GO TO 898
0313      556  CONTINUE
0314          WRITE(1,555),LNC
0315          WRITE(5,555),LNC
0316      555  FORMAT(10X,'LIMIT NUMBER FOR REDUCED INSPECTION IS: ',I9)
0317          898  RETURN
0318          END

```

```
0001      FUNCTION PP(N,P,K)
0002      Q=1. -P
0003      PP=Q**N
0004      IF(K.EQ.0)RETURN
0005      DO 20 I=1,K
0006      20  PP=PP*P*(N-I+1)/(Q*I)
0007      RETURN
0008      END
```

0001 FUNCTION B(N,P,K)
0002 PN=P*N
0003 Q=1.0P
0004 IF (PN.GE.0.5) GO TO 1
0005 B=EXP(PN)
0006 Z=EXP(-PN)
0007 IF (K.EQ.0) RETURN
0008 DO 10 I=1,K
0009 Z=Z*PN/I
0010 10 B=B+Z
0011 RETURN
0012 1 B=Q**N
0013 Z=Q**N
0014 IF (K.EQ.0)RETURN
0015 DO 20 I=1,K
0016 Z=Z*(N-I+1)*P/(Q*I)
0017 20 B=B+Z
0018 RETURN
0019 END

```

0001      SUBROUTINE INVERT (NR, AQ, BQ)
0002      *
0003      **** THIS SUBROUTINE INVERTS THE MATRIX BY GAUSSIAN ****
0004      *** ELIMINATION.                                     ***
0005      **** ELIMINATION.                                     ***
0006      **** ELIMINATION.                                     ***
0007      *
0008      REAL*8 AQ(20, 20), BQ(20, 20), ZTAMP, ATEMP
0009      DO 15 I=1, NR
0010      DO 10 J=1, NR
0011      10    BQ(I, J)=0.0
0012      15    BQ(I, I)=1.0
0013      DO 35 I=1, NR
0014      ZTAMP=AQ(I, I)
0015      DO 20 J=1, NR
0016      AQ(I, J)=AQ(I, J)/ZTAMP
0017      20    BQ(I, J)=BQ(I, J)/ZTAMP
0018      DO 30 II=1, NR
0019      IF (I.EQ. II) GO TO 30
0020      ATEMP=AQ(II, I)
0021      DO 25 J=1, NR
0022      AQ(II, J)=AQ(II, J)-AQ(I, J)*ATEMP
0023      25    BQ(II, J)=BQ(II, J)-BQ(I, J)*ATEMP
0024      30    CONTINUE
0025      35    CONTINUE
0026      RETURN
0027      END

```

```

0001      SUBROUTINE PLOTDC(P, T)
0002      C
0003      C***** THIS SUBROUTINE PLOTS DC, ASN, AND AFI CURVES FOR ****
0004      C***** THE FULL RANGE OF INCOMING FRACTION DEFECTIVE. ****
0005      C***** ****
0006      C
0007      C
0008      DIMENSION U(11), T(30), P(30), LINE(101)
0009      INTEGER ASTERK, BLANK, PLUS
0010      DATA ASTERK, BLANK, PLUS/'*', ' ', '+'/
0011      DO 1 K=1, 101
0012      1      LINE(K)=BLANK
0013      XMAX=T(1)
0014      XMIN=T(1)
0015      DO 2 I=1, 21
0016      IF(T(I).LT.XMIN) XMIN=T(I)
0017      IF(T(I).GT.XMAX) XMAX=T(I)
0018      2      CONTINUE
0019      IF(XMAX.LT.1) XMIN=0
0020      RANGE=XMAX-XMIN
0021      RG=RANGE/10
0022      U(1)=XMIN
0023      DO 3 I=2, 11
0024      3      U(I)=U(I-1)+RG
0025      WRITE(1, 130)(U(I), I=1, 11)
0026      WRITE(5, 130)(U(I), I=1, 11)
0027      DO 4 K=1, 101, 10
0028      4      LINE(K)=PLUS
0029      WRITE(1, 100)(LINE(K), K=1, 101)
0030      WRITE(5, 100)(LINE(K), K=1, 101)
0031      DO 6 K=1, 21
0032      6      DO 5 I=1, 101
0033      5      LINE(I)=BLANK
0034      KPRINT=100*(T(K)-XMIN)/RANGE+1.5
0035      LINE(1)=PLUS
0036      LINE(KPRINT)=ASTERK
0037      WRITE(1, 140)P(K), (LINE(I), I=1, 101)
0038      WRITE(5, 140)P(K), (LINE(I), I=1, 101)
0039      6      CONTINUE
0040      100     FORMAT(4X, 'PERCENT DEFECTIVE', 101A1)
0041      130     FORMAT(12X, 11(2X, E8.3))
0042      140     FORMAT(17X, F4.3, 101A1)
0043      RETURN
0044      END

```

```

0001      SUBROUTINE LNM(AQL, NZ, LNC)
0002      C
0003      C***** THIS SUBROUTINE FINDS THE LIMIT NUMBER ****
0004      C** FOR REDUCED INSPECTION. **
0005      C***** **** **** **** **** **** **** **** ****
0006      C
0007      C
0008      LNC=222
0009      IF(NZ.LE.29.AND.AQL.LE.15) LNC=0
0010      IF(NZ.GE.30.AND.NZ.LE.49.AND.AQL.LE.10) LNC=0
0011      IF(NZ.GE.50.AND.NZ.LE.79.AND.AQL.LE.6.5) LNC=0
0012      IF(NZ.GE.80.AND.NZ.LE.129.AND.AQL.LE.4.0) LNC=0
0013      IF(NZ.GE.130.AND.NZ.LE.199.AND.AQL.LE.2.5) LNC=0
0014      IF(NZ.GE.200.AND.NZ.LE.319.AND.AQL.LE.1.5) LNC=0
0015      IF(NZ.GE.320.AND.NZ.LE.499.AND.AQL.LE.1.0) LNC=0
0016      IF(NZ.GE.500.AND.NZ.LE.799.AND.AQL.LE.0.65) LNC=0
0017      IF(NZ.GE.800.AND.NZ.LE.1249.AND.AQL.LE.0.40) LNC=0
0018      IF(NZ.GE.1250.AND.NZ.LE.1999.AND.AQL.LE.0.25) LNC=0
0019      IF(NZ.GE.2000.AND.NZ.LE.3149.AND.AQL.LE.0.15) LNC=0
0020      IF(NZ.GE.3150.AND.NZ.LE.4999.AND.AQL.LE.0.10) LNC=0
0021      IF(NZ.GE.5000.AND.NZ.LE.7999.AND.AQL.LE.0.065) LNC=0
0022      IF(NZ.GE.8000.AND.NZ.LE.12499.AND.AQL.LE.0.040) LNC=0
0023      IF(NZ.GE.12500.AND.NZ.LE.19999.AND.AQL.LE.0.025) LNC=0
0024      IF(NZ.GE.20000.AND.NZ.LE.31499.AND.AQL.LE.0.015) LNC=0
0025      IF(NZ.GE.31500.AND.NZ.LE.49999.AND.AQL.LE.0.010) LNC=0
0026      IF(LNC.EQ.0) GO TO 10
0027      IF(NZ.LE.29) THEN
0028          IF(AQL.EQ.25)LNC=2
0029          IF(AQL.EQ.40)LNC=4
0030          IF(AQL.EQ.65)LNC=8
0031          IF(AQL.EQ.100)LNC=14
0032      ENDIF
0033      IF(NZ.GE.30.AND.NZ.LE.49) THEN
0034          IF(AQL.EQ.15)LNC=1
0035          IF(AQL.EQ.25)LNC=3
0036          IF(AQL.EQ.40)LNC=7
0037          IF(AQL.EQ.65)LNC=13
0038          IF(AQL.EQ.100)LNC=22
0039      ENDIF
0040      IF(NZ.GE.50.AND.NZ.LE.79) THEN
0041          IF(AQL.EQ.10)LNC=2
0042          IF(AQL.EQ.15)LNC=3
0043          IF(AQL.EQ.25)LNC=7
0044          IF(AQL.EQ.40)LNC=14
0045          IF(AQL.EQ.65)LNC=25
0046          IF(AQL.EQ.100)LNC=40
0047      ENDIF
0048      IF(NZ.GE.80.AND.NZ.LE.129) THEN
0049          IF(AQL.EQ.6.5)LNC=2
0050          IF(AQL.EQ.10)LNC=4
0051          IF(AQL.EQ.15)LNC=7
0052          IF(AQL.EQ.25)LNC=14
0053          IF(AQL.EQ.40)LNC=24
0054          IF(AQL.EQ.65)LNC=42
0055          IF(AQL.EQ.100)LNC=68
0056      ENDIF
0057      IF(NZ.GE.130.AND.NZ.LE.199) THEN

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0059      IF(AQL.EQ.4.0)LNC=2
0060      IF(AQL.EQ.6.5)LNC=4
0061      IF(AQL.EQ.10)LNC=7
0062      IF(AQL.EQ.15)LNC=13
0063      IF(AQL.EQ.25)LNC=25
0064      IF(AQL.EQ.40)LNC=42
0065      IF(AQL.EQ.65)LNC=72
0066      IF(AQL.EQ.100)LNC=115
0067      ENDIF
0068      IF(NZ.GE.200.AND.NZ.LE.319)THEN
0069          IF(AQL.EQ.2.5)LNC=2
0070          IF(AQL.EQ.4.0)LNC=4
0071          IF(AQL.EQ.6.5)LNC=8
0072          IF(AQL.EQ.10)LNC=14
0073          IF(AQL.EQ.15)LNC=22
0074          IF(AQL.EQ.25)LNC=40
0075          IF(AQL.EQ.40)LNC=68
0076          IF(AQL.EQ.65)LNC=115
0077          IF(AQL.EQ.100)LNC=181
0078      ENDIF
0079      IF(NZ.GE.320.AND.NZ.LE.499)THEN
0080          IF(AQL.EQ.1.5)LNC=1
0081          IF(AQL.EQ.2.5)LNC=4
0082          IF(AQL.EQ.4)LNC=8
0083          IF(AQL.EQ.6.5)LNC=14
0084          IF(AQL.EQ.10)LNC=24
0085          IF(AQL.EQ.15)LNC=39
0086          IF(AQL.EQ.25)LNC=68
0087          IF(AQL.EQ.65)LNC=113
0088          IF(AQL.EQ.100)LNC=189
0089      ENDIF
0090      IF(NZ.GE.500.AND.NZ.LE.799)THEN
0091          IF(AQL.EQ.1.0)LNC=2
0092          IF(AQL.EQ.1.5)LNC=3
0093          IF(AQL.EQ.2.5)LNC=7
0094          IF(AQL.EQ.4.0)LNC=14
0095          IF(AQL.EQ.6.5)LNC=25
0096          IF(AQL.EQ.10)LNC=40
0097          IF(AQL.EQ.15)LNC=63
0098          IF(AQL.EQ.25)LNC=110
0099      ENDIF
0100      IF(NZ.GE.800.AND.NZ.LE.1249)THEN
0101          IF(AQL.EQ.0.65)LNC=2
0102          IF(AQL.EQ.1.0)LNC=4
0103          IF(AQL.EQ.1.5)LNC=7
0104          IF(AQL.EQ.2.5)LNC=14
0105          IF(AQL.EQ.4.0)LNC=24
0106          IF(AQL.EQ.6.5)LNC=42
0107          IF(AQL.EQ.10)LNC=68
0108          IF(AQL.EQ.15)LNC=105
0109          IF(AQL.EQ.25)LNC=181
0110      ENDIF
0111      IF(NZ.GE.1250.AND.NZ.LE.1999)THEN
0112          IF(AQL.EQ.0.40)LNC=2
0113          IF(AQL.EQ.0.65)LNC=4
0114          IF(AQL.EQ.1.0)LNC=7

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0115 IF(AQL.EQ.1.5)LNC=13
0116 IF(AQL.EQ.2.5)LNC=24
0117 IF(AQL.EQ.4.0)LNC=40
0118 IF(AQL.EQ.6.5)LNC=69
0119 IF(AQL.EQ.10)LNC=110
0120 IF(AQL.EQ.15)LNC=169
0121 ENDIF
0122 IF(NZ.GE.2000.AND.NZ.LE.3149)THEN
0123 IF(AQL.EQ.0.25)LNC=2
0124 IF(AQL.EQ.0.40)LNC=4
0125 IF(AQL.EQ.0.65)LNC=8
0126 IF(AQL.EQ.1.0)LNC=14
0127 IF(AQL.EQ.1.5)LNC=22
0128 IF(AQL.EQ.2.5)LNC=40
0129 IF(AQL.EQ.4.0)LNC=68
0130 IF(AQL.EQ.6.5)LNC=105
0131 IF(AQL.EQ.10)LNC=181
0132 ENDIF
0133 IF(NZ.GE.3150.AND.NZ.LE.4999)THEN
0134 IF(AQL.EQ.0.15)LNC=1
0135 IF(AQL.EQ.0.25)LNC=4
0136 IF(AQL.EQ.0.40)LNC=8
0137 IF(AQL.EQ.0.65)LNC=14
0138 IF(AQL.EQ.1.0)LNC=24
0139 IF(AQL.EQ.1.5)LNC=38
0140 IF(AQL.EQ.2.5)LNC=67
0141 IF(AQL.EQ.4.0)LNC=111
0142 IF(AQL.EQ.6.5)LNC=186
0143 ENDIF
0144 IF(NZ.GE.5000.AND.NZ.LE.7999)THEN
0145 IF(AQL.EQ.0.10)LNC=2
0146 IF(AQL.EQ.0.15)LNC=3
0147 IF(AQL.EQ.0.25)LNC=7
0148 IF(AQL.EQ.0.40)LNC=14
0149 IF(AQL.EQ.0.65)LNC=25
0150 IF(AQL.EQ.1.0)LNC=40
0151 IF(AQL.EQ.1.5)LNC=63
0152 IF(AQL.EQ.2.5)LNC=110
0153 IF(AQL.EQ.4.0)LNC=181
0154 ENDIF
0155 IF(NZ.GE.8000.AND.NZ.LE.12499)THEN
0156 IF(AQL.EQ.0.065)LNC=2
0157 IF(AQL.EQ.0.10)LNC=4
0158 IF(AQL.EQ.0.15)LNC=7
0159 IF(AQL.EQ.0.25)LNC=14
0160 IF(AQL.EQ.0.40)LNC=24
0161 IF(AQL.EQ.0.65)LNC=42
0162 IF(AQL.EQ.1.0)LNC=68
0163 IF(AQL.EQ.1.5)LNC=105
0164 IF(AQL.EQ.2.5)LNC=181
0165 ENDIF
0166 IF(NZ.GE.12500.AND.NZ.LE.19999)THEN
0167 IF(AQL.EQ.0.040)LNC=2
0168 IF(AQL.EQ.0.065)LNC=4
0169 IF(AQL.EQ.0.10)LNC=7
0170 IF(AQL.EQ.0.15)LNC=13
0171 IF(AQL.EQ.0.25)LNC=24

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171 IF (AQL.EQ.0.40)LNC=40
0173 IF (AQL.EQ.0.65)LNC=69
0174 IF (AQL.EQ.1.0)LNC=110
0175 IF (AQL.EQ.1.5)LNC=167
0176 ENDIF
0177 IF (NZ.GE.20000.AND.NZ.LE.31499)THEN
0178 IF (AQL.EQ.0.025)LNC=2
0179 IF (AQL.EQ.0.040)LNC=4
0180 IF (AQL.EQ.0.065)LNC=8
0181 IF (AQL.EQ.0.10)LNC=14
0182 IF (AQL.EQ.0.15)LNC=22
0183 IF (AQL.EQ.0.25)LNC=40
0184 IF (AQL.EQ.0.40)LNC=68
0185 IF (AQL.EQ.0.65)LNC=115
0186 IF (AQL.EQ.1.0)LNC=181
0187 ENDIF
0188 IF (NZ.GE.31500.AND.NZ.LE.49999)THEN
0189 IF (AQL.EQ.0.015)LNC=1
0190 IF (AQL.EQ.0.025)LNC=4
0191 IF (AQL.EQ.0.040)LNC=8
0192 IF (AQL.EQ.0.065)LNC=14
0193 IF (AQL.EQ.0.10)LNC=24
0194 IF (AQL.EQ.0.15)LNC=38
0195 IF (AQL.EQ.0.25)LNC=67
0196 IF (AQL.EQ.0.40)LNC=111
0197 IF (AQL.EQ.0.65)LNC=186
0198 ENDIF
0199 IF (NZ.GE.50000)THEN
0200 IF (AQL.EQ.0.010)LNC=2
0201 IF (AQL.EQ.0.015)LNC=3
0202 IF (AQL.EQ.0.025)LNC=7
0203 IF (AQL.EQ.0.040)LNC=14
0204 IF (AQL.EQ.0.065)LNC=25
0205 IF (AQL.EQ.0.10)LNC=40
0206 IF (AQL.EQ.0.15)LNC=63
0207 IF (AQL.EQ.0.25)LNC=110
0208 IF (AQL.EQ.0.40)LNC=181
0209 IF (AQL.EQ.0.65)LNC=301
0210 ENDIF
0211 CONTINUE
0212 RETURN
0213 END

```

Program PROBS1.FOR

```

0001      SUBROUTINE PROBS1(NN,P,Q,BXLEC
0002      C***** THIS SUBROUTINE COMPUTES CUMULATIVE BINOMIAL
0003      C PROBABILITIES
0004      C***** INTEGER C
0005      C      DOUBLE PRECISION SUMLOG
0006      C
0007      COMMON/BLK7/SUMLOG(4000)
0008      C      COMMON/BLK8/N
0009      C
0010      C      Q=1.-P
0011      C***** BINOMIAL PROB. WHEN C=0
0012      C***** CSUMS=Q**NN
0013      C      IF (C.EQ.0) GOTO 45
0014      C***** AVOID RECOMPUTING SUMLOG(I)'S ALREADY IN MEMORY
0015      C***** IF (N.NN) 10,25,25
0016      10 M=N+1
0017      C***** COMPUTE N SUMLOGS-EQUIVALENT TO N-FACTORIAL
0018      C***** IF (M.GT.1) GOTO 15
0019      SUMLOG(1)=0.
0020      IF(NN.LE.1) GOTO 25
0021      M=2
0022      15 DO 20 I=M,NN
0023          SUMLOG(I)=DLOG10(DFLOAT(I))+SUMLOG(I-1)
0024      20 CONTINUE
0025      C***** COMPUTE C SUMS-EQUIVALENT TO SSUM OF PROB. COMPIN.
0026      C      I.E. CUMULATIVE BINOMIAL DISTRIBUTION COMPUTATION
0027      C***** 25 IF(NN.GT.N) N=NN
0028      C***** DETERMINE BEST NUMBER HANDLING LOOP
0029      C***** IF (NN.GT.300) GOTO 35
0030      DO 30 K=1,C
0031          CSUMS=10.**(SUMLOG(NN)-SUMLOG(NN-K)-SUMLOG(K))
0032          1          *P**K*Q**((NN-K)+CSUMS
0033      30 CONTINUE
0034      GOTO 45
0035      C***** LOOP FOR LARGE EXPONENTS
0036      C***** 35 DO 40 K=1,C
0037          CSUMS=10.**(SUMLOG(NN)-SUMLOG(NN-K)-SUMLOG(K)
0038          1          +K*DLOG10(DBLE(P))+(NN-K)*DLOG10(DBLE(Q)))+CSUMS
0039      40 CONTINUE
0040      C
0041      45 BXLEC = CSUMS
0042      RETURN
0043      END

```

Program PROBD1.FOR

```
0001      SUBROUTINE PROBD1(N1,N2,I,DPROB) C
0002      C*****SUBROUTINE PROBD1*****C
0003      C THIS SUBROUTINE COMPUTES DOUBLE PROBABILITIES FOR
0004      C COMPUTING SECOND SAMPLE NUMBER OF DOUBLE SAMPLING NUMBER
0005      C*****SUBROUTINE PROBD1*****C
0006      COMMON/BLK6/C1,C2
0007      INTEGER C1,C2,R1
0008      C
0009      IF(K.EQ.1) CALL PROBS1(N1,P,C1,BXLEC)
0010      IF(K.EQ.2) CALL PROBS2(N1,P,C1,BXLEC)
0011      DPRQB=BXI EC
0012      TEMP=BXI EC
0013      N1I=MP-C1+1
0014      K1I=MP-R1+1
0015      DO 10 IX=NTEMP,KTEMP
0016      I=IX
0017      I=IX-1
0018      IF(K.EQ.1) CALL PROBS1(N1,P,I,BXLEC)
0019      IF(K.EQ.2) CALL PROBS2(N1,P,I,BXLEC)
0020      PROB1=BXI EC-TEMP
0021      TEMP=BXI EC
0022      IF(K.EQ.1) CALL PROBS1(N2,P,J,BXLEC)
0023      IF(K.EQ.2) CALL PROBS2(N2,P,J,BXLEC)
0024      DPRQB=DPRQB+(PROB1*BXLEC)
0025      10 CONTINUE
0026      C
0027      RETURN
0028      END
```

END

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